Iowa Department of Natural Resources
Surface Water Monitoring and 303(d) Listing Evaluation

Interim Report

EPA Region 7

June 2003

CONTENTS

FIGURES

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1. INTRODUCTION

This report represents an interim assessment and summary of the Iowa Department of Natural Resources' (IDNR) surface water monitoring program and Clean Water Act (CWA) section 303(d) listing program. Completion of a study of Iowa's surface water monitoring program was one of the requirements established in the settlement of a complaint filed against the U.S. Environmental Protection Agency by SAILORS, Inc. and Mississippi River Revival and the Sierra Club in 2001. This interim report represents the findings of the study at the midpoint of the stipulated 36 month assessment period and also identifies areas for additional evaluation prior to completion of the final report. The report also includes some preliminary recommendations for program improvement.

IDNR's monitoring program is designed to assess compliance of Iowa's rivers, streams, lakes and wetlands with applicable surface water quality standards. Data collected by IDNR, cooperating agencies, and volunteers are used to identify impaired waterbodies for inclusion on the section 303(d) list. Under Section 303(d) of the Clean Water Act, states are required to identify waterbodies for which technology-based controls required by the Act are not sufficient to attain the state's water quality standards, and prioritize such waterbodies for TMDL establishment. This report describes and evaluates the data collected and statistical methods used to determine whether a waterbody in Iowa meets applicable water quality standards.

A brief overview of Iowa's water resources and water quality concerns is presented in the remainder of this section. Iowa's monitoring and listing procedures are described and evaluated in Section 2 and 3. Section 4 provides recommendations for improving IDNR's monitoring and listing programs.

1.1. Iowa's Land and Water Resources

Iowa has an area of 55,869 square miles and is home to 2.9 million people (US Census Bureau, 2001). Iowa has an extensive surface water body network that includes 26,630 miles of perennial streams and 42,957 miles of intermittent streams and more than 160,000 acres in lakes, ponds, and reservoirs (IDNR, 2001). Selected Iowa waterbodies are classified for designated beneficial uses within the Iowa Water Quality Standards [Iowa Administrative Code Chapter 567-61]. This state administrative code describes and classifies designated uses for 1068 streams and stream segments, 279 lakes and 88 wetlands (IDNR, 2001; IAC, 1990, 1996).

Surface waters in Iowa not classified within Iowa's Water Quality Standards for designated beneficial uses are classified for general uses, such as livestock and wildlife watering, noncontact recreation, crop irrigation, and industrial, agricultural, domestic and other incidental water withdrawal uses. Only about 17 percent of Iowa's total stream/river miles, and only 46 percent of perennial stream miles, have a designated primary beneficial use (IDNR, 2001). IDNR reports that streams classified only for general uses are typically the intermittent headwater reaches of larger streams that flow only for short periods of time following precipitation events or flow as a

result of discharge from wastewater treatment facilities and that the low flow characteristics of such streams generally preclude beneficial uses for swimming, aquatic life, or as a source of drinking water (IDNR, 2001).

The current estimate of wetland acreage in Iowa is 50,271 acres, although the state has adopted no formal generally accepted definition of "wetland". The majority of this wetland acreage is located in the prairie pothole region of north-central Iowa. No distinction is made between "lakes" and "wetlands" in the Iowa Water Quality Standards; however, IDNR indicates that 88 wetlands have been classified for designated beneficial uses, with 10 wetlands having a primary contact recreational use designation and one wetland having a drinking water designated use.

Publicly-owned lakes constitute 92,816 acres of the more than 160,000 acres of lakes, ponds and reservoirs in Iowa, with flood control reservoirs constituting an additional 40,850 acres of that total. All of the flood control reservoirs and 47,603 acres of the 92,816 acres of publicly-owned lakes have been classified as having designated beneficial uses (IDNR 2001).

The state of Iowa has been subdivided into a series of ecoregions and subregions (Figure 1) that reflect regional variations in ecological and biological conditions (IDNR 2001, Omernik et al. 1993). This division was carried out, in part, to aid the management of aquatic resources and the development of appropriate biocriteria for assessing water quality conditions (IDNR 2001).

1.2. Water Quality Concerns

A number of environmental problems have been identified by IDNR as state-wide concerns which have the potential to produce significant water quality impacts in Iowa (IDNR, 2001). These observed problems fall under several major categories and are summarized below.

Agricultural Concerns

- Agricultural nonpoint sources of pollution are the source of many of the impairments to water quality documented in Iowa, in part due to the magnitude of agricultural land use in Iowa (over 85% of the state's surface area is devoted to agricultural uses (USDA 1997)) and the potential for agricultural practices to deliver large amounts of sediment, nutrients, and pesticides to surface waters. The Iowa Water Quality Standards, however, do not contain water quality numeric criteria for the most common nonpoint source pollutants (particularly sediment and nutrients) (IDNR, 2001). Therefore, these types of pollutants are assessed based upon narrative explanations.

- Large-scale concentrated animal feeding operations (CAFOs) have increased significantly in number in Iowa over the last decade and present a significant threat to the quality of Iowa's surface waters and groundwater. Discharges to streams from such operations have resulted in some of the most extensive fish kills in Iowa that have been documented over the last 25 years. Current resources and state-level regulatory authority is too limited to

adequately monitor and protect the state's water resources from discharges from such facilities (IDNR, 2001).

- The water quality of Iowa's publicly-owned lakes and other high priority waterbodies is threatened by some types of agricultural and/or urban development. However, IDNR lacks authority to regulate pollution-generating developments in publicly-owned lakes and other high priority waterbodies and can respond to a threat only after a stream segment has been impacted. Currently, specific state-level authority to regulate such activities is lacking (IDNR, 2001).

Destruction of Aquatic Habitats

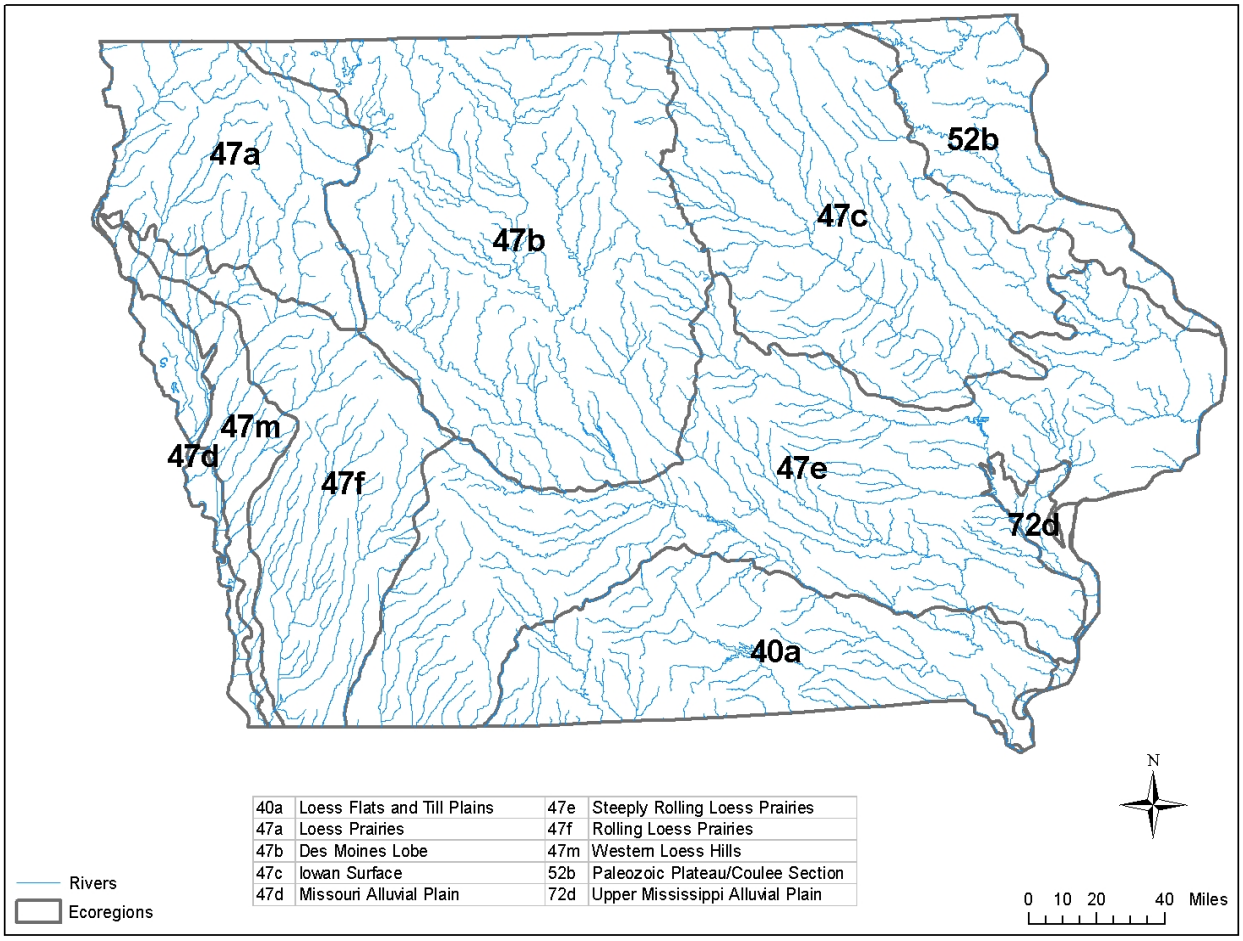
- Physical alteration of aquatic habitats (channelization) is the most common cause of impact to the overall quality of Iowa's rivers and streams and limits the ability of streams to support a healthy population of fish. If a pollutant is not identified, hydrologic modification is not, by itself, a basis for requiring a TMDL to be prepared. However, existing programs for protecting river and stream corridors are judged to be inadequate for protecting those streams from alterations to protect the quality of aquatic habitats (IDNR, 2001).

- Appearance and proliferation of non-native aquatic nuisance species (such as the zebra mussel, Eurasian water millfoil, etc.) in Iowa water has the potential to significantly impact aquatic life and aquatic habitats. Research is needed to identify the most effective methods for controlling impacts resulting from the presence of these species (IDNR, 2001).

General Issues

- IDNR reports the existence of anecdotal evidence suggesting that the ability of large rivers to assimilate the cumulative point source discharges of municipal and industrial wastewater treatment plants may have been exceeded in some areas. Factors contributing to this over allocation include failure to adequately account for upstream contributors, lack of adequate monitoring to characterize upstream ambient water quality for determining wasteload allocations (a particular problem along border rivers) and reliance on water quality criteria that do not account for potential toxic impacts in river sediments (e.g., from ammonia) (IDNR, 2001).

- Poorly designed and maintained residential wastewater treatment systems are a suspected source of fecal coliform bacteria impacts to state lakes. The extent of this suspected problem is currently undefined (IDNR, 2001).



40a	Loess Flats and Till Plains	47e	Steeply Rolling Loess Prairies
47a	Loess Prairies	47f	Rolling Loess Prairies
47b	Des Moines Lobe	47m	Western Loess Hills
47c	Iowan Surface	52b	Paleozoic Plateau/Coulee Section
47d	Missouri Alluvial Plain	72d	Upper Mississippi Alluvial Plain

Figure 1. Locations of ecoregions and subregions of the Western Corn Belt Plains ecoregion in the state of Iowa (after Omernik et al. 1993).

2. IDNR'S SURFACE WATER MONITORING PROGRAMS

Surface water monitoring in the state of Iowa is a responsibility of the IDNR. IDNR's surface water monitoring program utilizes water quality data from several sources for purposes of water quality planning and assessment. IDNR has established a monitoring program strategy and monitoring objectives that guide the development and implementation of its monitoring program. The monitoring program, its goals and objectives, and monitoring coverage are summarized in the following sections. Material used in this compilation include Iowa's 305(b) report for the years 1998 & 1999 (IDNR, 2001), Methodology for developing Iowa's 2002 Section 303(d) list of Impaired Waters (IDNR, 2002), and the Iowa Water Monitoring Plan (IDNR, 2000).

2.1. Iowa's Monitoring Program Strategy and Objectives

The general purpose of Iowa's monitoring program is to provide quantitative and qualitative information on the physical, chemical, and biological characteristics of the state's surface waters. Goals of surface water monitoring are as follows (IDNR 2000):

1. Define the condition of Iowa's water resources.

2. Characterize existing and emerging problems by type, magnitude, and geographic extent.

3. Provide information for designing and implementing abatement, control, and management programs.

4. Measure changes and identify trends in water resource quality.

5. Provide information to evaluate program effectiveness.

6. Report information in useful formats to inform Iowa's citizens about their water resources.

7. Involve Iowa citizens in monitoring to increase their appreciation and understanding of their water resources.

2.2. Iowa's Monitoring Programs

2.2.1. Networks and Programs

The Iowa surface water quality monitoring program consists of both IDNR managed monitoring networks and programs and those of cooperating agencies. Figure 2 illustrates the locations of all monitoring stations within this linked network. The following specific monitoring networks and programs represent significant components of IDNR's integrated surface water monitoring program:

IDNR maintains a system of fixed monitoring stations that are targeted toward medium to large-sized interior streams in the state (IDNR, 2001). Sixty-two fixed stations are monitored monthly to provide uniform state-wide coverage of eight-digit hydrologic unit code (HUC 8) basins (basins with >250,000 acres). Analytes include common herbicides, bacteria indicators and all priority pollutants (April through July only). Seven of these 62 stations (1 in each ecological region) are further targeted for supplemental sampling during run-off events. Ten of the larger interior cities are monitored monthly both upstream and downstream at 23 sites (6 of which are among the 62 fixed stations) to look at aggregate urban effects on water quality (IDNR, 2000). Priority pollutants are monitored at these sites on a monthly basis from April to July. Figure 3 illustrates station locations of monitoring points within IDNR's STORET database, which includes all monitoring locations within their fixed station network.

132 lakes in the state are currently being monitored 3 times per year as part of a five year monitoring program to document annual variability among lakes as well as general variability within each lake (IDNR 2002b)(Figure 4). A variety of field, chemical, and biological parameters are monitored including secchi disk transparency, temperature profile, pH profile, DO profile, TDS profile, specific conductivity profile, turbidity profile, chlorophyll and pigment profile, total P, dissolved P, nitrite + nitrate, NH_4, unionized NH_3, total N, silica, alkalinity, pH, TSS, inorganic suspended solids, volatile suspended solids, particle size distribution, phytoplankton composition, zooplankton composition, and priority pollutants (IDNR 2002b). 35 state-owned beaches are also being monitored weekly during summer months for indicator bacteria (fecal coliform, Enterococci, E. coli), total suspended sediment, DO, pH, temperature, and turbidity (IDNR, 2000).

Since the 1998-99 Section 305(b) reporting cycle, IDNR has been using biological criteria (biocriteria) to assess support of aquatic life uses at selected locations and annually collects biocriteria data from a series of sampling stations in the state (IDNR 2001). Biocriteria are indicators of stream biological integrity which utilize the Benthic Macroinvertebrate Index of Biotic Integrity (BM-IBI) and a Fish Index of Biotic Integrity (F-IBI) to summarize biological sampling data and provide a broad assessment of stream biological conditions (IDNR, 2002). To date, approximately 313 stream segments have been sampled either for reference conditions or evaluation purposes (Figure 5). Currently approximately 40 different test sites are sampled per year (IDNR 2002). Repeat sampling at individual locations are expected to occur on about a 5

year cycle (Olson 2003).

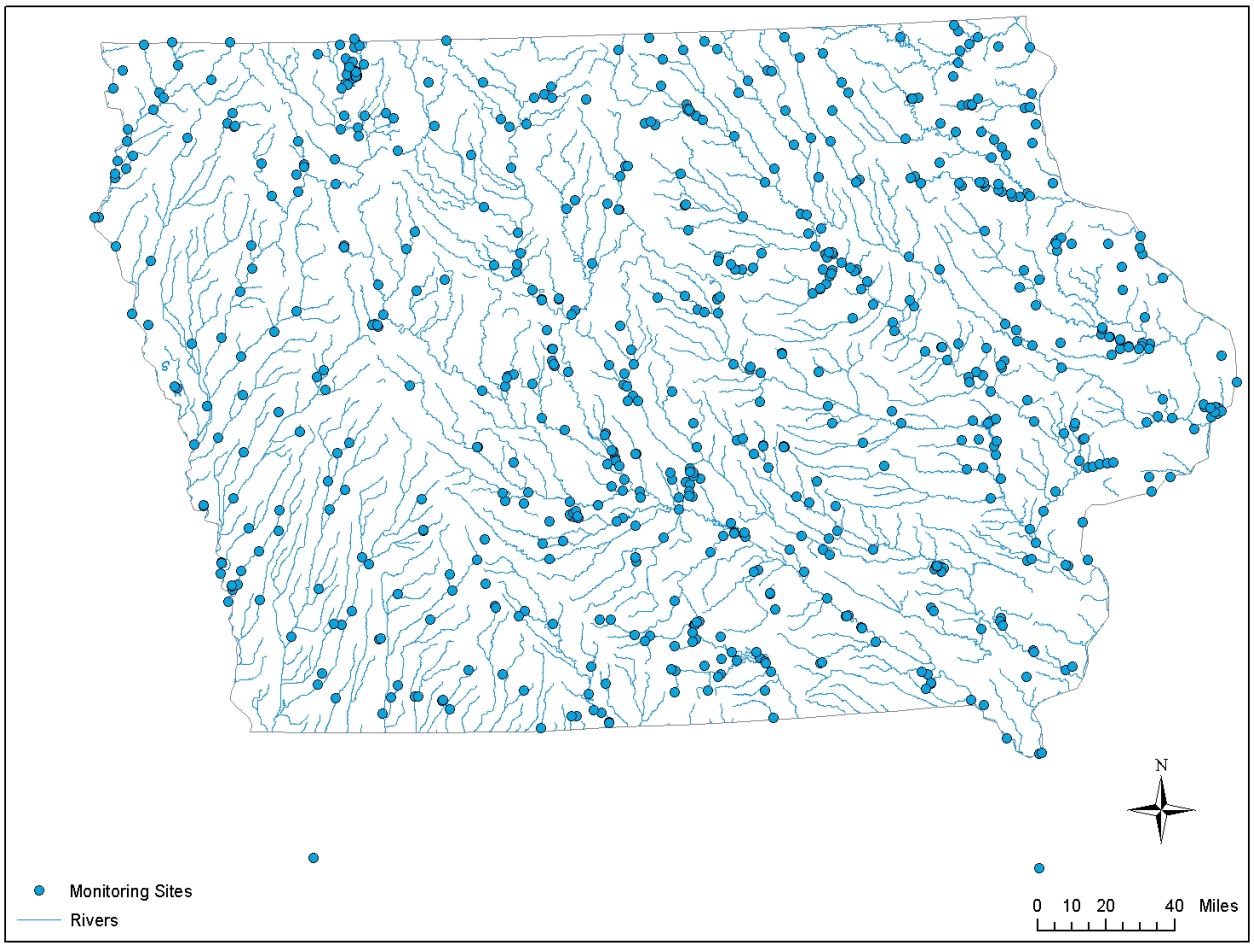


Figure 2. Locations of All Sampling Sites with Location Data from IDNR Databases, 1998-2003. The two data points located south of Iowa's borders represent data collected by neighboring states on the Missouri and Mississippi Rivers which is also evaluated by Iowa.

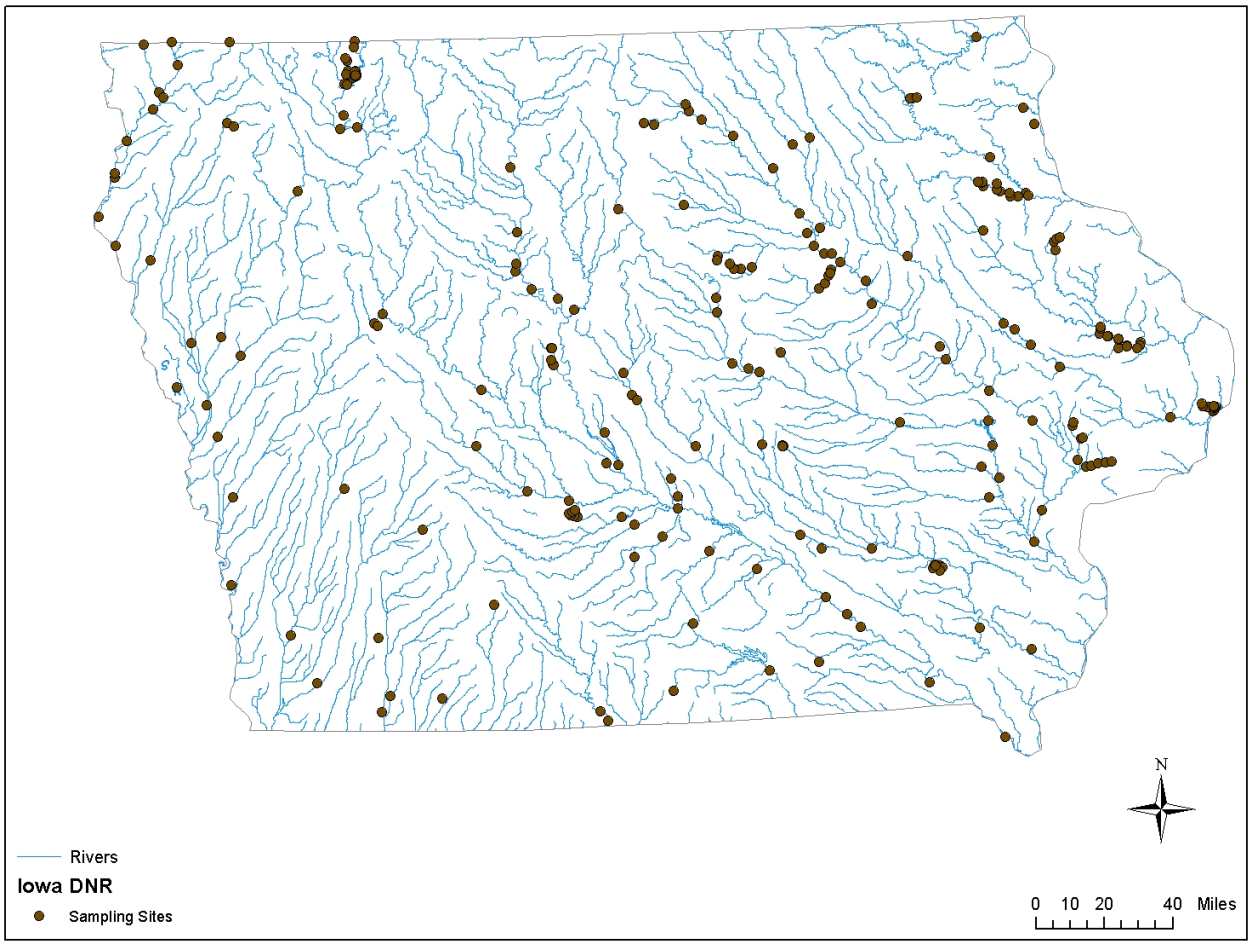


Figure 3. Locations of Sampling Sites with Location Data from IDNR STORET Database, 1998-2003. These Data include fixed stations within the ambient monitoring program, beach sampling sites, sampling sites associated with major cities, etc.

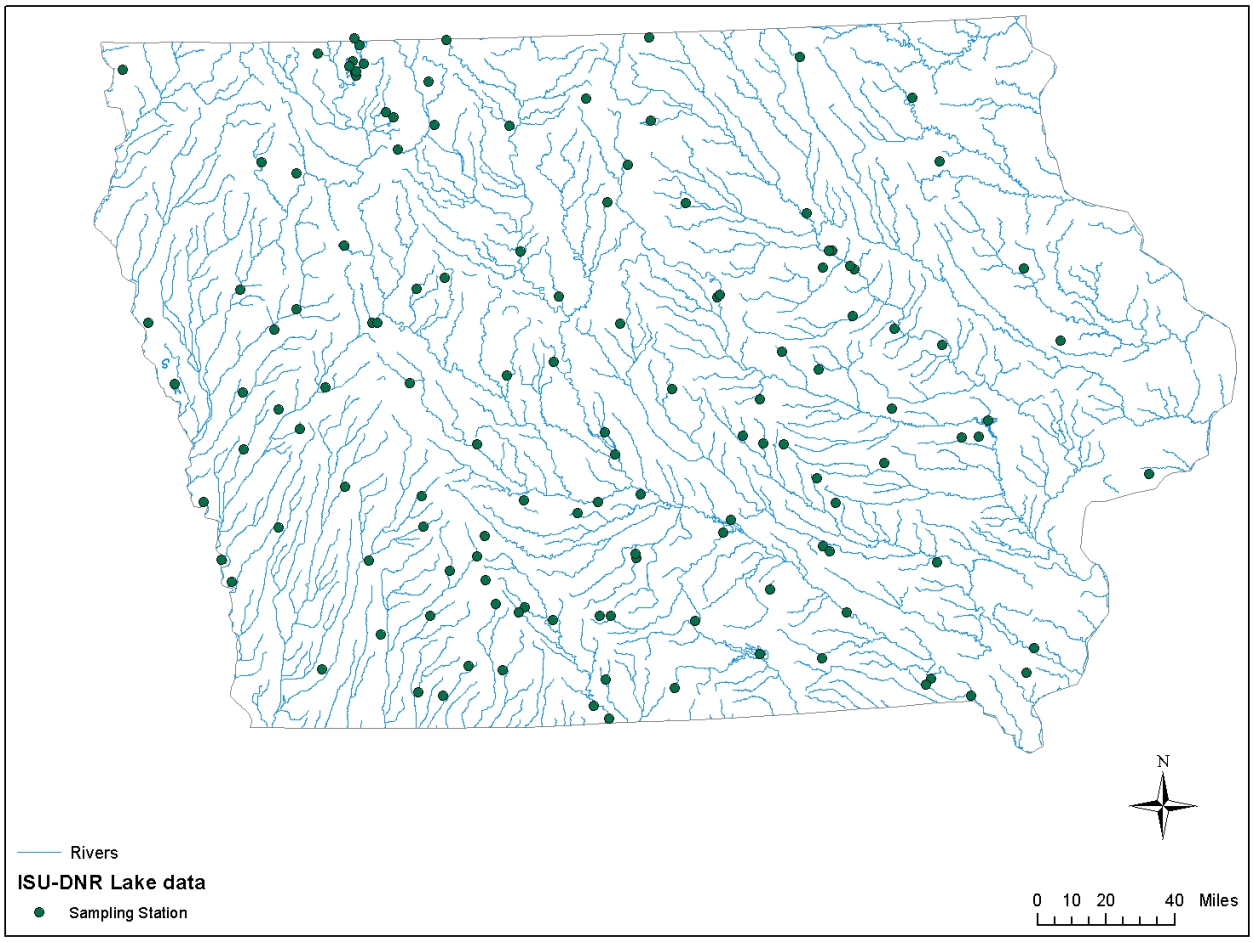


Figure 4. Locations of Sampling Sites with Location Data from the ISU-DNR Lakes Study, 2000-2003.

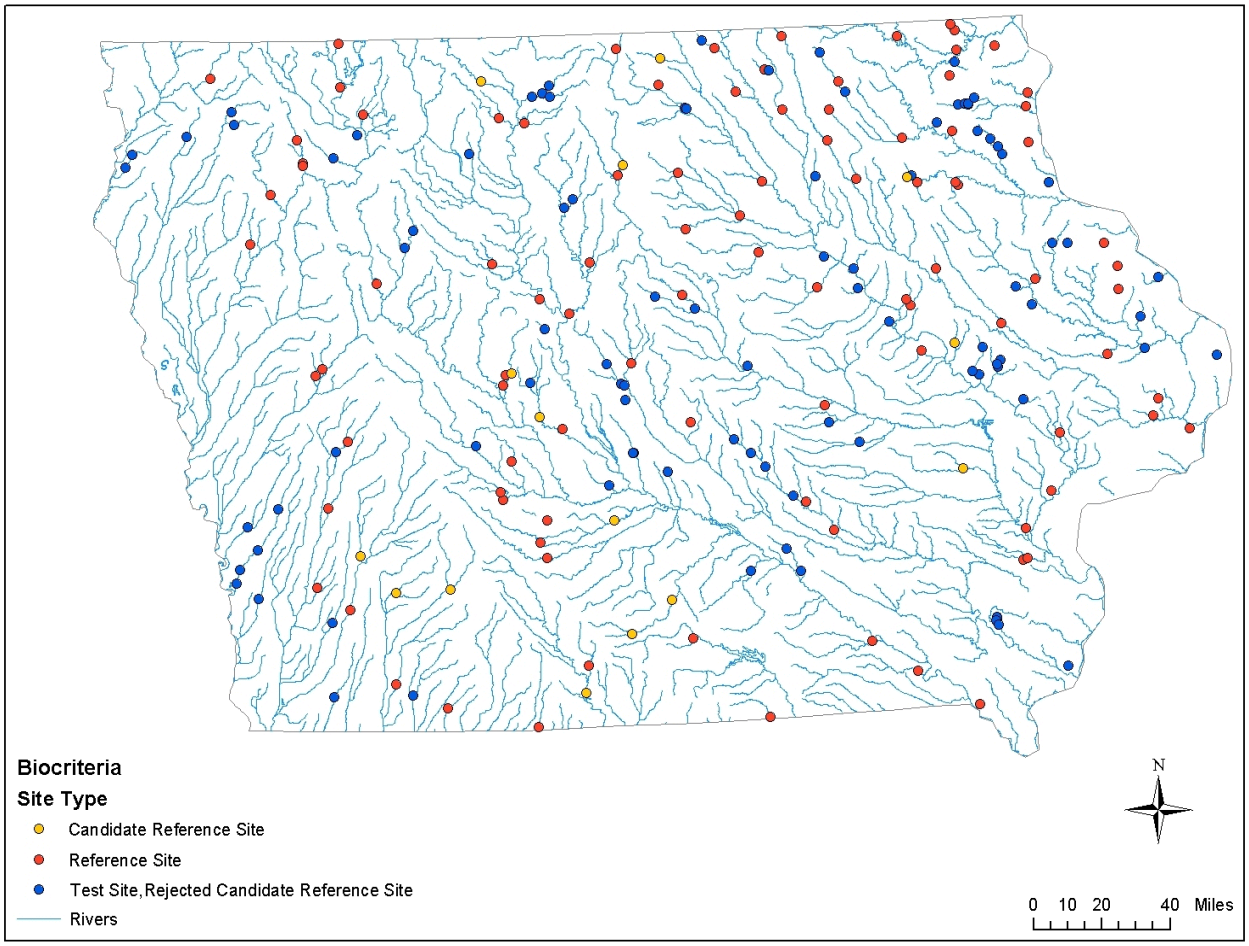


Figure 5. Locations of Sampling Sites with Location Data from the IDNR Biocriteria Database, 1998-2003. Rejected Candidate Reference Sites were sites initially considered as possible references sites that were rejected and are now considered test sites.

Fish kill reports are routinely investigated either by IDNR's Fisheries Bureau or IDNR's Compliance and Enforcement Bureau. Data from these investigations, including the location, size of the waterbody affected and cause and source of the kill, are recorded in IDNR's Fish Kill Database and used in the water quality assessment process.

IDNR recently initiated a probabilistic survey of the state's stream resources as part of the R-EMAP program. This survey, which began in 2002, will be completed over a four-year period and will target randomly selected stream sites in each of Iowa's ten ecological regions. A total of 225 stream segments will be selected with 25% of the selected sites being sampled every year. The survey is intended to gauge stream ecosystem health through the following five major sampling components: 1) aquatic community (benthic macroinvertebrates and fish); 2) fish tissue and sediment contaminants; 3) primary productivity and aquatic community respiration; 4) water chemistry; and 5) riparian and stream physical habitat (IDNR 2002b).

In addition to IDNR-directed monitoring, IDNR also coordinates water quality monitoring activities with several other agencies that conduct their own surface water quality monitoring in Iowa. Long-term ambient water quality monitoring is being conducted by several cooperating agencies. The U.S. Army Corps of Engineers (USACE) has contracted with both Iowa State University at Ames and the University of Iowa at Iowa City to conduct water monitoring at federal flood control reservoirs on the Des Moines and Iowa rivers (Figure 6). The U.S. Fish and Wildlife Service collects biweekly to monthly water quality data from March to September on Walnut and Squaw Creeks as part of the Walnut Creek Watershed Restoration and Water Quality Monitoring Project. IDNR also evaluates water quality data collected by the Cedar Rapids Water Department and Des Moines Water Works.

The IDNR is working with the Rathbun Land and Water Alliance (RLWA) to supplement existing monitoring on Rathbun Lake and to support future studies to measure the nutrient flux within the watershed. The Rathbun Lake Watershed Project is a monthly water quality sampling initiative conducted by the RLWA whose intent is to monitor for water quality impacts and to assess threats to this regionally important water supply reservoir.

The USGS has conducted sporadic sampling at up to 39 stream sites in Iowa as part of the National Ambient Water-Quality Assessment Program (NAWQA)(see May et al. 1999 and Nalley et al. 2000). Sampling at NAWQA sites has recently entered a low-intensity phase where sampling has continued on a regular basis at only four sites. Data from these four sites are utilized by IDNR in their assessment program (Olson 2003). The USGS also collects data at two fixed stations on Iowa's border rivers as part of the National Stream Water Quality Network (NASQAN). These two stations are located on the Mississippi River at Clinton and on the Missouri River at Omaha. USGS data on border rivers is supplemented by data provided by environmental agencies of neighboring states who maintain fixed monitoring stations on these rivers. IDNR currently does not conduct state-directed monitoring on the large border rivers.

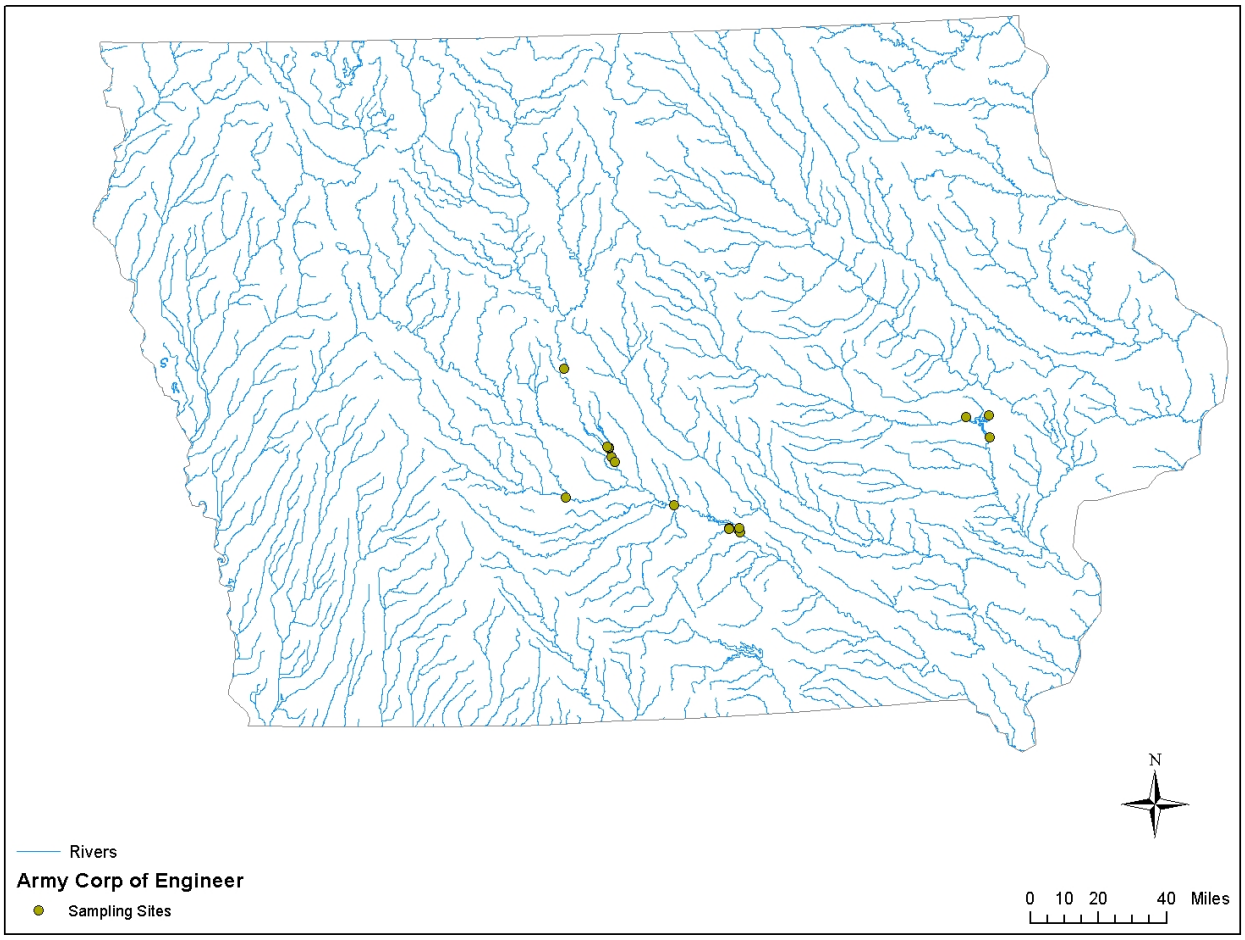


Figure 6. Locations of U.S. Army Corps of Engineers Sampling Sites in Iowa with Location Data from IDNR Database, 1998-2003.

Annual monitoring for bioaccumulative toxics in fish tissue is currently conducted in Iowa as part of two long-term programs: 1) U.S. EPA's Regional Ambient Fish Tissue (RAFT) Monitoring Program (Figure 7), and 2) water quality studies being conducted as part of the U.S. Army Corps of Engineers reservoir monitoring program. Sampling locations for the latter program are located on the Des Moines river near Saylorville and Red Rock Reservoirs and on the Iowa River near Coralville Reservoir (IDNR 2002). Sporadic fish tissue monitoring is also conducted by USACE at Rathbun Reservoir. The RAFT program currently involves analysis for 19 pesticides and 4 toxic metals. The RAFT program further entails monitoring for trends in levels of toxics in bottom feeding fish (common carp) at ten fixed sites on Iowa's larger rivers as well as follow-up monitoring designed to determine if contaminant levels are sufficiently high to warrant issuance of consumption advisories (IDNR 2002).

The Iowa volunteer monitoring program (IOWATER) was established in 2000 and provides training, equipment, and supplies to volunteers collecting monitoring data on streams throughout the state. The volunteer program currently provides two levels of training. Level one training includes: a simple habitat assessment, manual measurements of stream flow, and chemical tests using field kits for nitrate, phosphorus, pH, and dissolved oxygen. Level two training includes test methods for bacteria and chloride, modules for standing waters (lakes, ponds, wetlands) and soil, and quantitative assessment of macroinvertebrates. Guidance on preparation of quality assurance project plans is also provided (IDNR 2002). While not collected as part of the IOWATER program, atrazine data collected by Syngenta (Figure 8) is currently the only data being voluntarily collected that meets the requirements for Section 303(d) listing specified in Iowa's credible data legislation.

To avoid duplication of effort, all of the foregoing monitoring programs developed by outside agencies and groups have been taken into account in the design of IDNR's ambient water quality monitoring network. Data from the foregoing sampling efforts are then used in combination with IDNR-generated data to evaluate surface water quality in the state and assess progress toward attaining IDNR's monitoring objectives.

With regard to the state's wetlands, neither IDNR nor other agencies in Iowa routinely monitor water quality on Iowa's publicly-owned wetlands and, instead, IDNR has historically relied upon observations and best professional judgment of biologists within the IDNR Wildlife Bureau for making aquatic life use support assessments. Use of this data for Section 303(d) listing purposes ended in 2000, however, with the enactment of Iowa's credible data law and its requirement that listing decisions be based on actual monitoring data. No assessments are made on privately-owned wetlands.

2.2.2. Quality Assurance/Quality Control Program

The IDNR Environmental Protection Division has developed and adopted a quality management plan (IDNR, 1998) that describes the quality assurance policies and procedures that have been established to ensure that all environmental data collected by the division are of known and documented quality. This quality management plan also identifies the programs and

environmental data collection activities covered by the Division's quality assurance program and the quality assurance roles and responsibilities for Division staff involved in the collection of environmental data (IDNR, 2001).

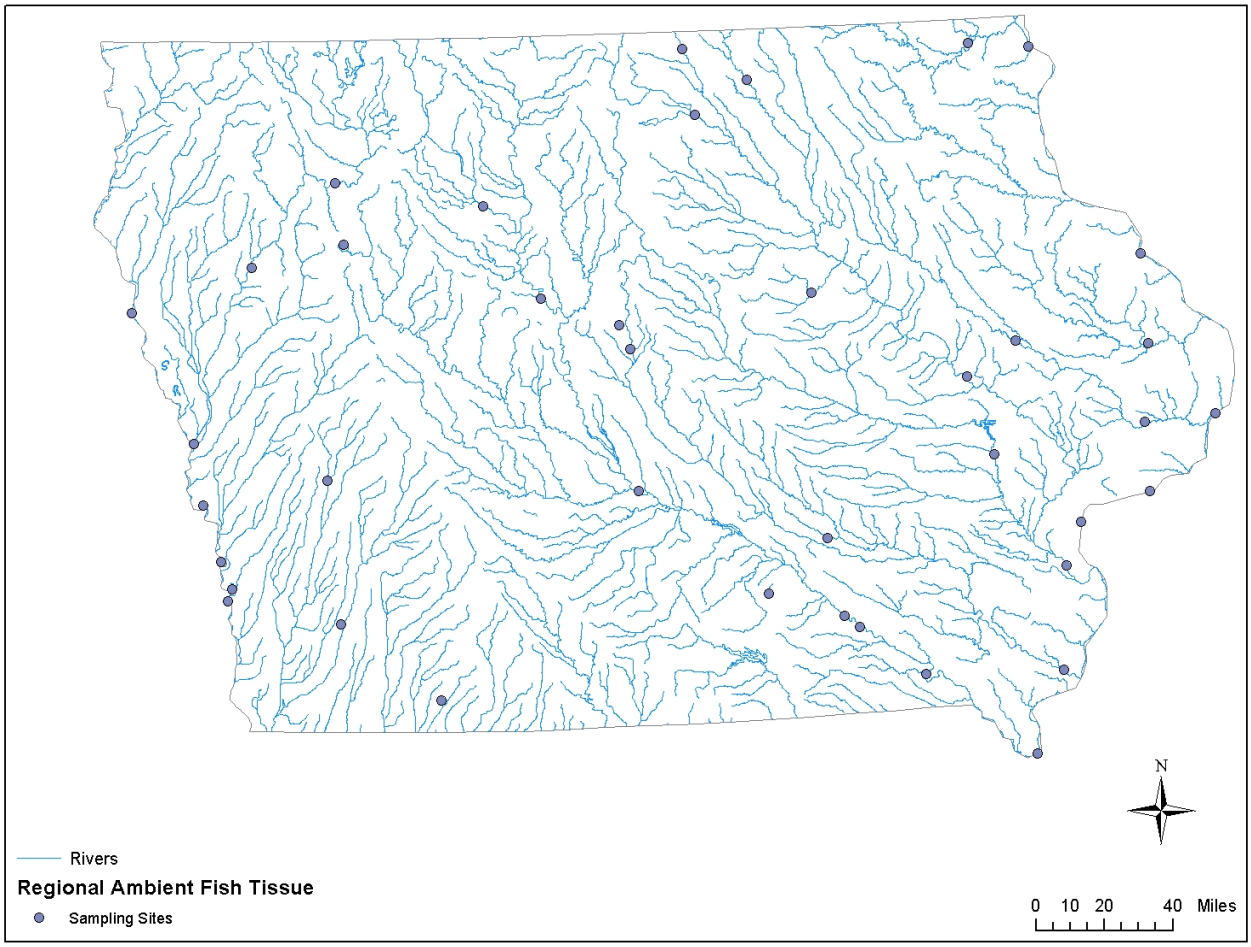


Figure 7. Locations of Regional Ambient Fish Tissue (RAFT) Sampling Sites in Iowa from U.S. EPA's STORET Database, 1998-2003.

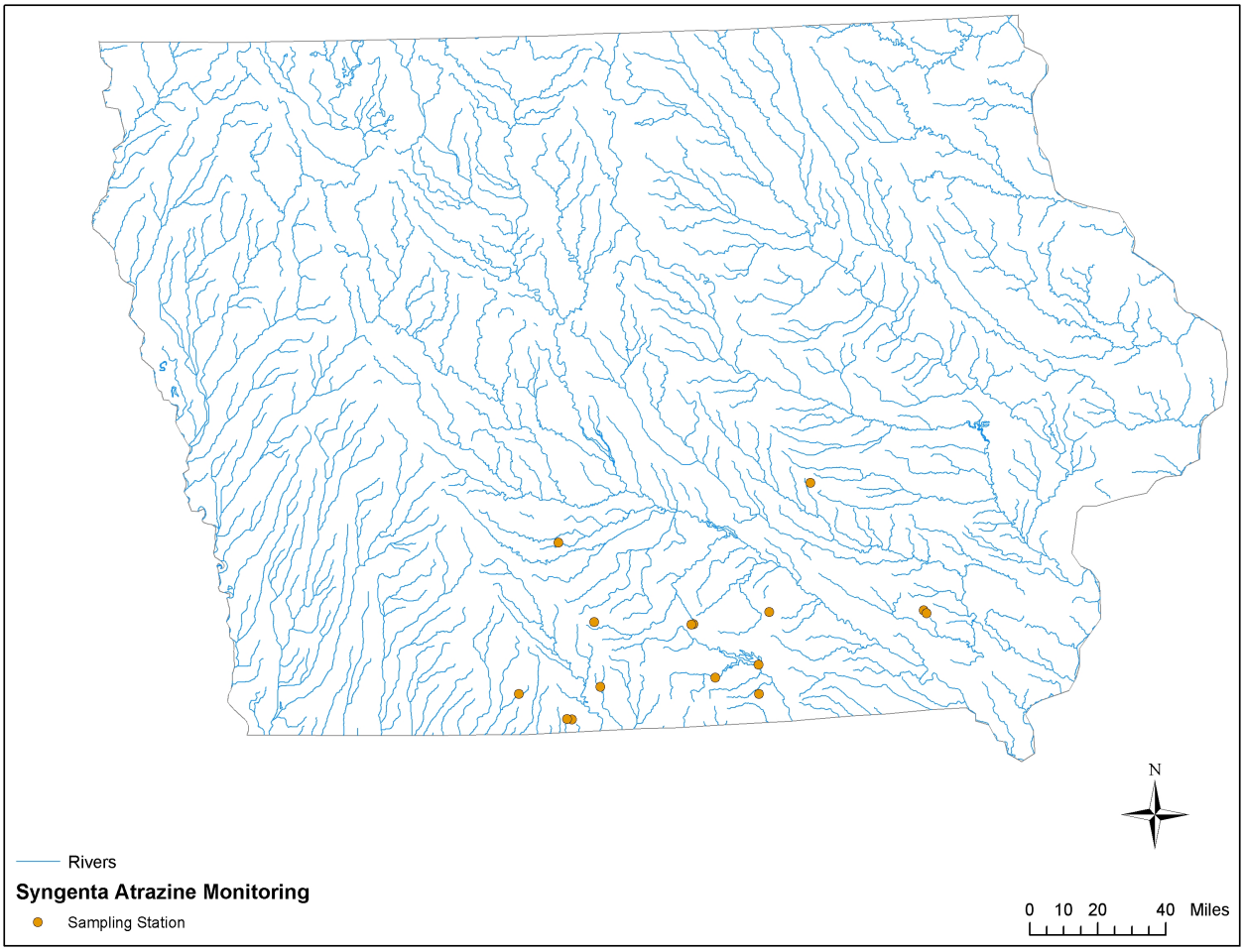


Figure 8. Locations of Sites Sampled by Syngenta for Atrazine, 1998-2003.

All IDNR monitoring networks and special studies are further governed by a quality assurance/quality control (QA/QC) work plan. IDNR QA/QC work plans have been developed in accordance with EPA's Guidance for Quality Assurance Project Plans (EPA, 1998) (IDNR, 2001).

2.2.3. Data Storage/Access

Historically, IDNR had entered all water quality monitoring data generated by routine ambient IDNR monitoring programs in the U.S. EPA's STORET database. This practice ended after 1998 when an updated STORET system was introduced. A transitional period occurred between the two systems from 1999 to 2000 when data were temporarily stored in excel data files but those data have now been transferred into the new system. Currently, all ambient monitoring data is being directly entered into the new STORET system. The new system is designed to run on Oracle and is installed on a server which allows direct access through the Internet. Internet access currently allows limited data searches and will eventually be expanded to include mapping and graphing capabilities. The Iowa STORET data is annually uploaded to EPA's STORET system (IDNR 2001, IDNR 2002b).

Storage of monitoring data collected by cooperating agencies and as part of specialized projects is currently fragmented with much of it being held in separate Microsoft Excel data files. Plans are in progress to coordinate the entering of this data into STORET and, thereby, consolidate most of the data used in IDNR's assessment program.

IDNR is in the process of transferring data collected as part of the biological monitoring program to EPA's EDAS biological database. All future biological data generated through the biological monitoring and TMDL programs is expected to be entered into this database (IDNR 2002b).

2.2.4. Characterization of Iowa's Monitoring Stations

Information Used in Analysis

IDNR's STORET database of ambient surface water quality data and data files of water quality data from other projects and sources were obtained from IDNR and used for this analysis. The data obtained represent, to the extent ascertainable, data currently being used by IDNR to assess compliance with state surface water quality standards and to determine support of designated beneficial uses. This data analysis focuses on the 5 most recent years of sampling and consists of data from over 700 sampling locations from the following sampling programs:

- IDNR fixed station water quality monitoring network;
- Biological monitoring being conducted by IDNR in cooperation with the University of Iowa Hygienic Laboratory (UHL) as part of a current effort to establish biological criteria
- IDNR-sponsored lake monitoring conducted by Iowa State University;
- Monitoring of bacterial indicators in rivers and at beaches of publicly-owned lakes;
- Water quality monitoring from neighboring states of IL, NE, and SD

- US Army Corps of Engineers reservoir monitoring
- USGS NAWQA & NASQAN monitoring programs
- Volunteer Monitoring Program (Syngenta atrazine monitoring)
- Rathbun Lake Watershed Project
- Walnut Creek Watershed Project
- Where available, data from public water supplies on the quality of raw and finished water

In addition to the sampling data, IDNR also provided station location information for the majority of the sampling stations. Location information was either in the form of latitude and longitude or was converted to latitude and longitude for purposes of this study. Other information used in the analysis included GIS coverage of the 6-digit, 8-digit, and 12-digit Hydrologic Unit Code (HUC) watersheds.

Analysis Approach

GIS analysis of station location data focused on the spatial distribution of monitoring stations and assessed how representative that distribution was of 8-digit and 12-digit HUC coverage. Specifically, sampling station location information was used with the Spatial Join function in ArcView to determine the number of stations located in 8-digit and 12-digit HUCs. The results of this analysis are presented in Table 1 and Figures 9 and 10. Figures 9 and 10 display the location and number of sampling sites by 8- and 12- digit HUC for the assembled data. Figure 11 shows the location of the major river basins, while Table 2 shows the distribution and percentage of sampling sites by major river basin.

The results of this analysis indicate that most 8-digit HUC watersheds (91%) contain at least one monitoring station. Furthermore, those 8-digit HUCs lacking monitoring stations are trans-border watersheds where the portion of the watershed lying in Iowa is relatively small in size. The four most significant 8-digit HUC watersheds in Iowa lacking routine monitoring are the Blue Earth, Nishnabotna, Lower Grand, and North Fabius. The 8-digit HUCs with the largest number of monitoring stations are the Little Sioux, Middle Des Moines, Lake Red Rock, Middle Cedar, and Turkey. The analysis of 12-digit HUC monitoring coverage reveals a far different level of coverage compared to that attained at the 8-digit HUC level, however, with 72% of 12-digit HUC watersheds lacking monitoring altogether.

Table 1. Number of Sampling Sites per 8- and 12- Digit HUC in Iowa.

HUC Type	**No Sites**	**1-10 Sites**	**11-30 Sites**	**More than 30 Sites**	**Total**
8-digit HUCs	6	33	21	5	65
HUC Type	**No Sites**	**1-10 Sites**	**11-30 Sites**	**More than 30 Sites**	**Total**
12-digit HUCs	1231	460	8	3	1702

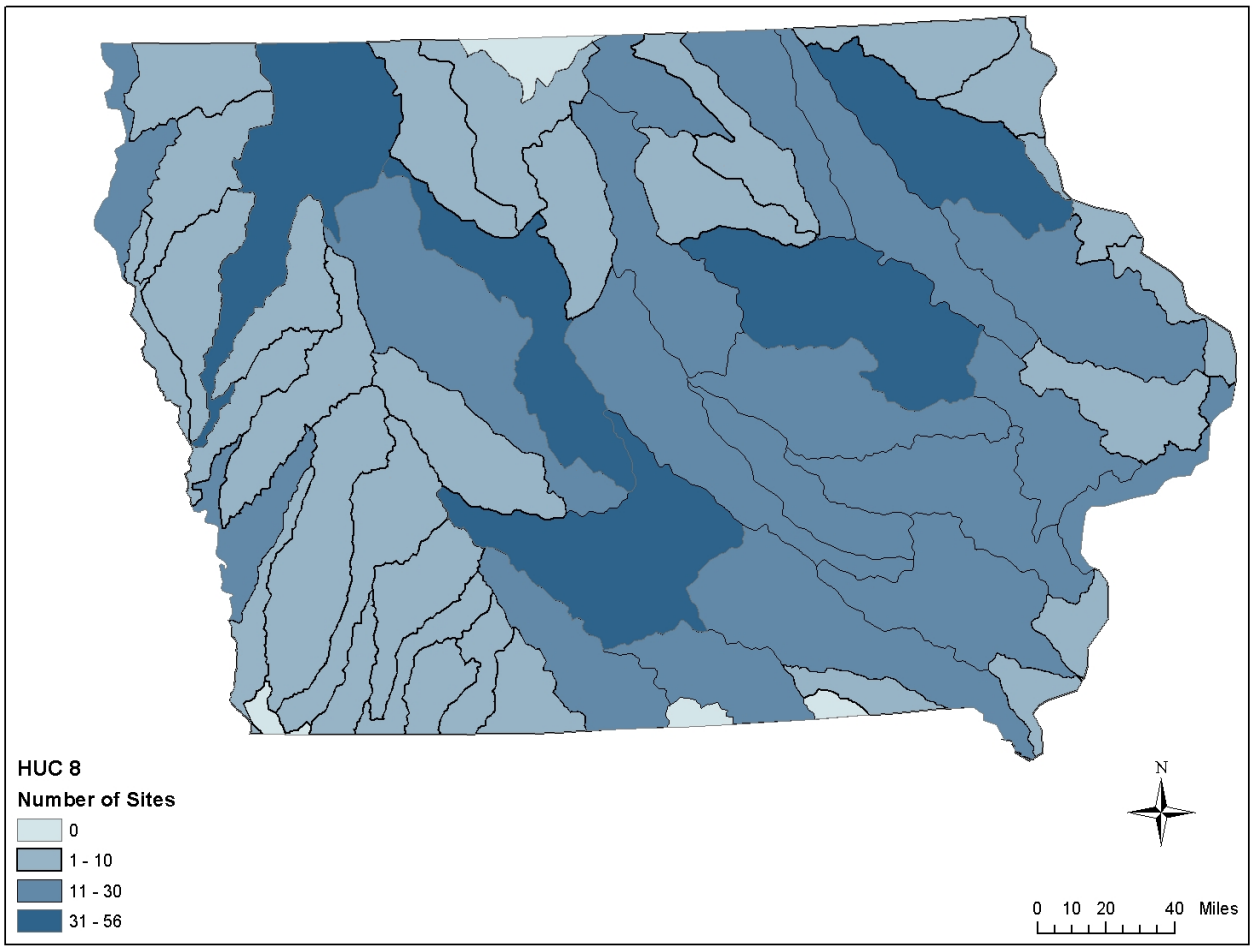


Figure 9. Distribution of Iowa Sampling Sites by 8-digit HUC with Location Data from IDNR Databases, 1998-2003.

Figure 10. Distribution of Iowa Sampling Sites by 12-digit HUC with Location Data from IDNR Databases, 1998-2003.

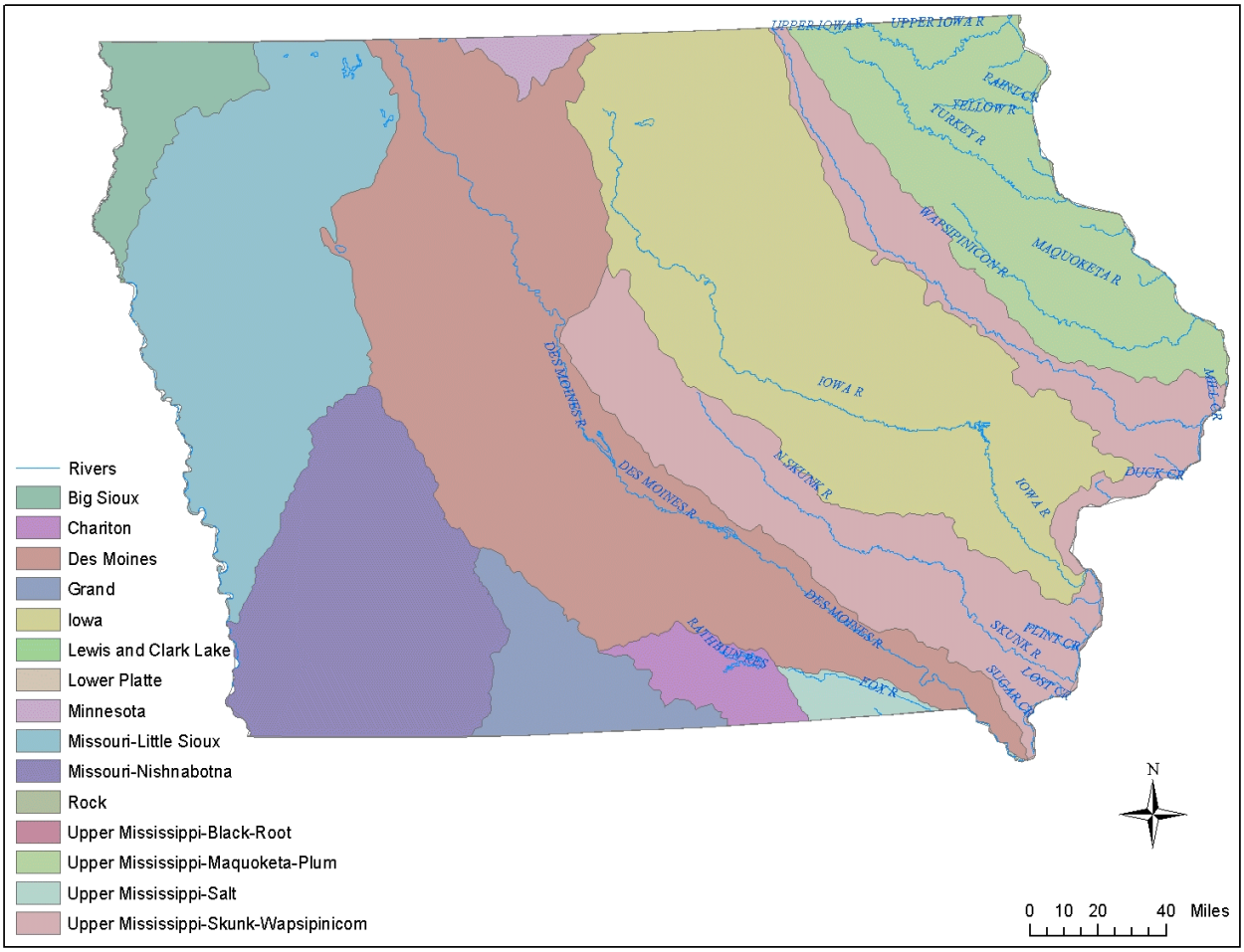


Figure 11. Location of Major (HUC 6) River Basins in Iowa.

Table 2. Summary of Spatial Coverage of Sampling Site by Major River [1] Basin in Iowa.

River Basin/HUC Name	HUC 6 Code	Area		Sampling Sites	
		Hectares	Percent	Number	Percent
Big Sioux	101702	357579.3	2.5	17	2.4
Chariton	102802	239293.7	1.6	26	3.7
Des Moines	71000	3323699.8	22.8	169	23.8
Grand	102801	453617.2	3.1	16	2.3
Iowa	70802	3003668.8	20.6	145	20.5
Lewis and Clark Lake	101701	262.5	0.0	0	0.0
Lower Platte	102002	13.8	0.0	0	0.0
Minnesota	70200	86488.7	0.6	0	0.0
Missouri-Little Sioux	102300	1975907.0	13.6	87	12.3
Missouri-Nishnabotna	102400	1459332.2	10.0	41	5.8
Rock	70900	3.3	0.0	0	0.0
Upper Mississippi-Black-Root	70400	65.9	0.0	0	0.0
Upper Mississippi-Maquoketa-Plum	70600	1463881.1	10.0	95	13.4
Upper Mississippi-Salt	71100	111119.0	0.8	0	0.0
Upper Mississippi-Skunk-Wapsipinicom	70801	2099090.4	14.4	113	15.9
Totals		**14574022.7**	**100.0**	**709**	**100.1**

[1] Major river basins are defined in this report as USGS 6-digit hydrologic cataloging unit (HUC) watersheds.

Sampling sites on 303(d) listed waters were also identified to determine whether a correlation exists between sampling and listing locations. Since many of the latitude and longitude locations for sampling stations were not the product of licensed surveying, some minor errors in referenced locations were possible. Therefore, a 0.5 mile buffer was used in connection with sample station locations when determining number of stations located on listed waters. Designated beneficial uses have been established by IDNR for approximately 12,186 miles of the 71,665 miles of rivers and streams in Iowa (17%) (IDNR 2001); of the river mileage with designated beneficial uses, 6,390 miles of rivers and streams were assessed for support of uses in the 2000 305(b) report (52%). Of the mileage of rivers and streams assessed for support of uses, 29.8% were classified as "impaired" (either not supporting or only partially supporting designated beneficial uses) (IDNR 2001). Of the 739 sampling sites in Iowa, 238 sites were found on a Section 303(d) listed reach (32%), which is proportionate with the percentage listed (30%). Figure 12 shows the location of the 303(d) listed streams and the sampling locations on those streams.

Parameters sampled and frequency of sample collection were also examined qualitatively for adequacy relative to supporting listing decisions for Iowa waterbodies. Both parameters sampled and frequency of sampling varied in accordance with the sampling program and type of sampling

being performed and this variation prevented derivation of "average" frequency of sampling and "primary" samples collected. As an example, a range of chemical, physical, bacteriological, and toxicity testing is performed monthly as part of IDNR's fixed station monitoring and USGS NAWQA program on rivers and streams, whereas the ISU/IDNR Lake Project targets monitoring of trophic state, nutrients, and chlorophyll 3 times per year.

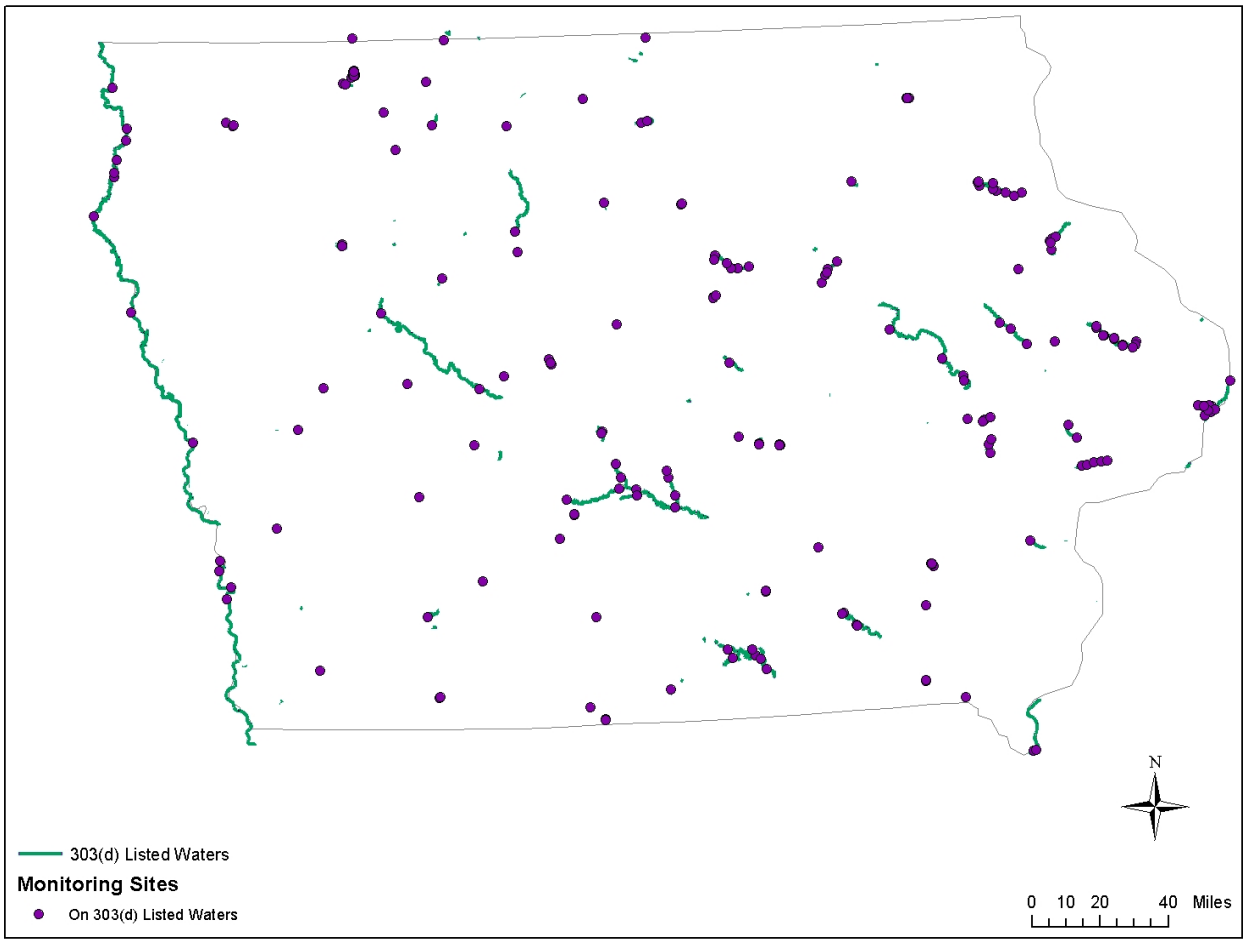


Figure 12. Locations of 1998 Section 303(d) Listed Waters in Iowa and All Monitoring Sites with Location Data (1998-2003) that are Located on Listed Waters.

3. IDENTIFICATION OF WATER QUALITY-LIMITED WATERS

In accordance with Section 305(b) of the federal Clean Water Act, the IDNR conducts assessments of state water quality monitoring data to determine whether beneficial uses are being achieved for state waterbodies and submits a report to the U.S. EPA containing the results of that assessment. This comparison of water quality data to designated beneficial uses and associated criteria then forms the basis for the addition of waters assessed as not fully attaining beneficial uses (i.e. impaired waterbodies) to the State's Section 303(d) list. An "impaired" determination is based upon a waterbody not meeting water quality standards, which could include designated uses, numeric criteria, narrative criteria, and/or anti-degradation requirements as defined in 40 CFR 131 (IDNR, 2002) and the Iowa Water Quality Standards [Iowa Administrative Code Chapter 567-61].

In 2000, the Iowa General Assembly enacted "credible data" legislation whose intent is to define what data may be used in making listing decisions. Where inconsistencies exist between federal regulations and Iowa's credible data law, IDNR has adopted a policy of noting the inconsistencies and making listing decisions in accordance with the Iowa State law (IDNR, 2002). This law specifically affects 303(d) listing and Total Maximum Daily Load (TMDL) development in the following ways (among others): disallows use of data more than five years old for listing purposes, disallows use of "best professional judgement" for listing purposes, disallows listing of impairments caused solely by violations of NPDES or stormwater permits where enforcement of the pollution control measures is required, and disallows listing of impairments where existing technology-based effluent limits or other required pollution control measures are adequate to achieve applicable water quality standards. Impairments that are of unknown cause may be added to the 303(d) list but the cause of impairment must be determined before a TMDL can be established.

3.1. Iowa's Beneficial Water Uses

Four classes of beneficial uses have been designated for surface waters in Iowa in the Iowa Water Quality Standards (IAC 1990, 1996).

1. Class A: Waters designated for primary contact recreational uses (i.e. swimming, water skiing).

2. Class B: Waters designated for wildlife, fish, aquatic and semiaquatic life and secondary contact recreational uses. Class B waters are subdivided into the following categories:

> **Class B(LR)(limited resource warmwater)**: Streams in which flow or other physical characteristics limit the ability of the waterbody to maintain a balanced warmwater community. Such waters support only populations composed of species adaptable to a wide range of physical and chemical conditions, and are not generally harvested for human consumption.

Class B(WW)(significant resource warmwater): Lakes or rivers in which temperature, flow and other habitat characteristics are suitable for the maintenance of a wide variety of reproducing populations of warmwater game fish and associated aquatic communities, including sensitive species.

Class B(CW)(coldwater aquatic life): Streams or lakes in which the temperature, flow, and other habitat characteristics are suitable for the maintenance of a wide variety of coldwater species, including nonreproducing populations of trout and associated aquatic communities.

Class B(LW)(lakes and wetlands): Artificial impoundments and natural lakes with hydraulic retention times and other physical and chemical characteristics suitable to maintain a balanced community normally associated with lake-like conditions.

3. Class C: Rivers or lakes that are designated as a raw source of potable water.

4. General Uses: All surface waters potentially used for livestock and wildlife watering, aquatic life, noncontact recreation, crop irrigation, and industrial, domestic, agricultural, and other incidental water withdrawal uses not protected by Class A, B, or C water quality criteria.

In addition to the foregoing categories, Iowa surface waters may also be identified as either **High Quality (HQ)** or **High Quality Resource (HQR)**. High Quality waters are those waters with exceptionally better quality than specified by Iowa water quality criteria and with exceptional recreational and ecological importance. High Quality Resource waters are those waters of substantial or ecological significance which possess unusual, outstanding or unique physical, chemical, or biological characteristics which enhance the beneficial uses and warrant special protection.

3.2. IDNR'S 2002 303(d) Listing Process

The first step in IDNR's process for determining whether designated beneficial uses or general uses have been impaired in classified water bodies is to determine whether data of sufficient quantity and quality are available for assessment purposes (IDNR 2002). In accordance with Iowa's credible data law, this includes a determination of whether data have been collected from those sites within the last 5 years (Iowa's credible data law dictates that data greater than 5 years old generally can not be used for listing purposes.) Following this data assessment, waters are classified as either fully supporting, fully supporting/threatened, partially supporting, or not supporting based upon level of use support. Waterbodies determined to be partially supporting, not supporting, or fully supporting/threatened with a declining water quality trend are candidates for listing under section 303(d) (IDNR 2002). Waterbodies with all classified uses assessed as either "fully supporting" or "fully supporting/threatened" are identified as attaining Clean Water Act goals (IDNR 2001).

3.2.1. Data Used for Listing

Based on guidance for Section 305(b) reporting provided to states by U.S. EPA (U.S. EPA 1997), IDNR subdivides water quality data collected for assessment purposes into two types. **Evaluated assessments** are based upon water quality information other than current quantitative site-specific data and includes assessments based on results of only a few grab samples and "best professional judgement". **Monitored assessments** are based on current data, defined as five years old or less, that is site-specific and believed to accurately represent water quality conditions. Subdivision of assessment data into these two categories commonly comes down to the quantity of data available. Thus, use support decisions based on "evaluated assessments" tend to have lower confidence than those based on "monitored assessments". To comply with requirements of Iowa's credible data law, IDNR only uses "monitored assessments" for purposes of section 303(d) listing (IDNR 2002).

Data adequacy (quantity) issues are addressed by "data completeness" guidelines developed by IDNR to avoid basing water quality assessments on inadequate amounts of water quality data and to reduce errors in assessments. The current version of IDNR's Section 305(b) data completeness guidelines is presented in Table 3.

3.2.2. Assessment of Compliance with Water Quality Standards

The status of Iowa's waterbodies is determined by their compliance with state water quality standards. Iowa's water quality standards list the uses for which classified streams and lakes are protected and the maximum concentrations of chemicals and bacteria allowable in those waters. All surface waters of the state are protected by narrative standards for aquatic life, livestock and wildlife watering, noncontact recreation, crop irrigation, and industrial, domestic, agricultural, and other incidental water withdrawal uses (IDNR 2001). The water quality standards for these uses are outlined in Table 4. Parameters monitored by IDNR for purposes of section 303(d) listing and standards for assessing attainment of the four classes of beneficial designated uses are outlined in Table 5. Methods for assessing the level of use support for the various designated beneficial uses are outlined in Tables 6a, 6b, and 6c.

Table 3. Data completeness guidelines for using results of routine ambient monitoring to make "monitored" assessments of beneficial uses (IDNR 2002).

DESIGNATED BENEFICIAL USE	TYPE OF INFORMATION	DATA REQUIRED
Aquatic Life	Data for levels of toxics in waterbodies designated for "fishable" (Class B) uses or classified for general uses.	Data collected quarterly or more frequently during the 3 most recent complete federal fiscal years (minimum of 10 samples).
	Data for levels of conventional pollutants (DO, pH, temp.) In waterbodies designated for "fishable" (Class B) uses or classified for general uses.	Data collected monthly or more frequently during one or both years of the current biennial period (minimum of 10 samples).
	Data from DNR biocriteria sampling at reference, test, and watershed sites.	Assessments conducted during the 5 most recent complete calendar years.
	Results of fish kill investigations.	Reports of pollutant-caused fish kills from the 5 most recent complete calendar years.
Fish Consumption	Data for levels of toxic contaminants in fish tissue in waterbodies designated for "fishable" (Class B) or classified for general uses.	All data on levels of toxic contaminants in fish tissue collected over the 5 most recent complete calendar years.
Primary Contact Recreation	Data for levels of fecal coliform bacteria from river waterbodies or non-beach areas of publicly-owned lakes and flood control reservoirs designated for swimmable (Class A) uses.	Data collected monthly or more frequently during April-October periods of the current biennial period; at least 10 samples need to be collected at flows not materially affected by surface runoff.
	Data for levels of fecal coliform bacteria from beach areas of publicly-owned lakes and flood control reservoirs.	At least five samples approximately equally spaced over a 30-day period during April-October periods of the current biennial period.
Drinking Water	Data for levels of toxics from waterbodies designated for drinking water (Class C) uses.	Data collected quarterly or more frequently during the 3 most recent complete federal fiscal years (minimum of 10 samples).
	Data for levels of nitrate from waterbodies designated for drinking water (Class C) uses.	Data collected monthly or more frequently during the current biennial period (minimum of 10 samples).

Table 4. General water quality criteria to protect beneficial general uses for all Iowa surface waters (Iowa Water Quality Standards, IAC, Section 61.3(2)).

1. All waters of the state shall be "free from" the following:
• substances attributable to point source wastewater dischargers that will settle to form sludge deposits;
• floating debris, oil, grease, scum and other materials from wastewater discharges or agricultural practices in amounts sufficient to create a nuisance;
• materials attributable to wastewater discharges or agricultural practices producing objectionable color, odor, or other aesthetically objectionable conditions;
• substances attributable to wastewater discharges or agricultural practices in concentrations or combinations which are acutely toxic to human, animal, or plant life;
• substances attributable to wastewater discharges or agricultural practices in quantities which would produce undesirable or nuisance aquatic life;
2. The turbidity of a receiving water shall not be increased by more than 25 nephelometric turbidity units by an point source discharge;
3. Total dissolved solids shall not exceed 750 mg/l in any lake or impoundment or in any stream with a flow rate equal to or greater than three times the flow rate of upstream point source dischargers;
4. Water which enters a sinkhole or losing stream segment shall not exceed a fecal coliform bacteria content of 200 organisms per 100 ml, except when the waters are materially affected by surface runoff; but in no case shall fecal coliform levels downstream from existing discharge which may contain pathogens to humans be more than 200 organisms per 100 ml higher than the background level upstream from the discharge. No new wastewater discharges will be allowed on watercourses which directly or indirectly enter sinkholes or losing stream segments.

Table 5. Summary of Iowa water quality criteria used to make assessments of support of beneficial designated uses of Iowa surface waters for purposes of Section 303(d) listing (IDNR 2002). The criteria are only for those parameters monitored in Iowa surface waters as part of the IDNR ambient monitoring network.

	DESIGNATED USE					
PARAMETER	**Class A: swimmable**	**Class B(WW): significant resource aquatic life**	**Class B(LR): limited resource aquatic life**	**Class B(CW): coldwater aquatic life**	**Class B(LW): aquatic life of lakes and wetlands**	**Class C: source of a water supply**
dissolved oxygen (mg/l) (24-hour minimum / 16-hour minimum)	none	5.0	5.0	7.0	5.0	none
temperature (added heat)	none	no increase > 3 C; increase < 1 C/hr; no increase above 32 C	no increase > 3 C; increase < 1 C/hr; no increase above 32 C	no increase > 2 C; increase < 1 C/hr; no increase above 20 C	no increase > 2 C; increase < 1 C/hr; no increase above 20 C	none
pH	not < 6.5; not > 9; max. change = 0.5 units	not < 6.5; not > 9; max. change = 0.5 units	not < 6.5; not > 9; max. change = 0.5 units	not < 6.5; not > 9; max. change = 0.5 units	not < 6.5; not > 9; max. change = 0.5 units	none
ammonia-nitrogen (mg/l)	none	criteria are dependent on the pH and temperature of the lake, stream or river; see Tables 3a through 3c of the *Iowa Water Quality Standards* (IAC 1990) for criteria for Class B(CW), B(WW), B(LW) and B(LR) waters.				
nitrate-nitrogen (mg/l)	none	none	none	none	none	MCL: 10
chloride (mg/l)	none	none	none	none	none	MCL: 250
fluoride (mg/l)	none	none	none	none	none	MCL: 4,000
fecal coliform bacteria	Apr.-Oct. #200 org./100ml when not mat. affected by surface runoff	none	none	none	none	none

PARAMETER	Class A: swimmable	Class B(WW): significant resource aquatic life	Class B(LR): limited resource aquatic life	Class B(CW): coldwater aquatic life	Class B(LW): aquatic life of lakes and wetlands	Class C: source of a water supply
TOXIC METALS (all values in µg/l; chronic/ acute/ human health criteria (HHC) are given; NA = value not applicable)						
arsenic	none	200 / 360 / NA	1000 / 1800 / NA	200 / 360 / NA	200 / 360 / NA	HHC: 018
cadmium	none	15 / 75 / 168	25 / 100 / NA	1 / 4 / 168	1 / 4 / 168	MCL: 5
chromium	none	40 / 60 / 3365	200 / 300 / NA	40 / 60 / 3365	10 / 15 / 3365	MCL: 100
copper	none	35 / 60 / 1000	55 / 90 / NA	20 / 30 / 1000	10 / 20 / 1000	HHC: 1300
cyanide	none	10 / 45 / NA	10 / 45 / NA	5 / 20 / NA	10 / 45 / NA	HHC: 700
lead	none	30 / 200 / NA	80 / 750 / NA	3 / 80 / NA	3 / 80 / NA	MCL: 50
mercury	none	2.1 / 4.0 / 0.15	3.7 / 6.9	3.5 / 6.5 / 0.15	0.91 / 1.7 / 0.15	HHC: 0.05
zinc	none	450 / 500 / 5000	2000 / 2200 / NA	200 / 220 / 5000	100 / 110 / 5000	HHC: 9100
PESTICIDES (all values in µg/l; chronic / acute / human health criteria (HHC) are given; NA = value not applicable)						
2,4 D	none	none	none	none	none	HHC: 100
2,4,5-TP (Silvex)	none	none	none	none	none	HHC: 10
alachlor	none	none	none	none	none	MCL: 2
atrazine	none	none	none	none	none	MCL: 3
carbofuran	none	none	none	none	none	MCL: 40
chloropyrifos	none	0.041 / 0.083 / NA	0.041 / 0.083/ NA	0.041 / 0.083 / NA	0.041 / 0.083 / NA	none
DDT+DDD+DDE	none	0.001 / 0.8 / 0.0059	0.029/ 0.95/ NA	0.001 / 0.8 / 0.0059	0.001 / 0.8 / 0.0059	HHC: 0.0059
dieldrin	none	0.056 / 0.24 / 0.0014	0.056/ 0.24/ NA	0.056 / 0.24 / 0.0014	0.056 / 0.24 / 0.0014	HHC: 0.0014
dinoseb	none	none	none	none	none	MCL: 7
lindane	none	NA / 0.95 / 0.63	NA / 0.95 / 0.63	NA / 0.95 / 0.63	NA / 0.95 / 0.63	HHC: 0.19

PARAMETER	Class A: swimmable	Class B(WW): significant resource aquatic life	Class B(LR): limited resource aquatic life	Class B(CW): coldwater aquatic life	Class B(LW): aquatic life of lakes and wetlands	Class C: source of a water supply
parathion	none	0.13 / 0.65 / NA	0.13 / 0.65 / NA	0.13 / 0.65 / NA	0.13 / 0.65 / NA	none
picloram	none	none	none	none	none	MCL: 500
simazine	none	none	none	none	none	MCL: 4

Tables 6a, 6b, and 6c. Methods for determining support of classified beneficial uses for Aquatic Life, Fish Consumption, Primary Contact Recreation, and Drinking Water for surface waters in Iowa (IDNR 2002).

AQUATIC LIFE USES					
		Beneficial Use "Fully Supported"		Beneficial Use "Impaired"	
Type of Waterbody	**Source of Information**	**Fully Supported**	**Fully Supported/ Threatened**	**Partially Supporting**	**Not Supporting**
Rivers, streams, lakes & flood control reservoirs	Data from ambient water quality monitoring during current biennial period	No violations of acute or chronic toxicity criteria in grab samples, criteria for conventional pollutants exceeded in # 10% of samples	Up to one violation of acute or chronic toxicity criteria if grab samples are collected quarterly or more frequently	Criteria for conventional pollutants exceeded in 11-25% of samples	> one violation of acute / chronic criteria if samples collected quarterly or more often; criteria for conventionals exceeded in > 25% of samples.
Warmwater Streams and Rivers	Stream biocriteria sampling data	Scores for both fish and macroinvertebrates indexes of biotic integrity significantly greater than the ecoregion / subecoregion biological impairment criterion	Scores for both fish and macroinvertebrates indexes of biotic integrity approximately equal to the ecoregion / subecoregion biological impairment criterion	Scores for one of indexes of biotic integrity (fish or macroinvertebrates) significantly less than the ecoregion / subecoregion biological impairment criterion	Scores for both indexes of biotic integrity (fish and macroinvertebrates) significantly less than the ecoregion / subecoregion biological impairment criterion
Coldwater Streams	Stream biocriteria sampling data	Two or less of the eight biological indicators less than the 25th percentile of the respective indicator value for Iowa coldwater streams	From two to four of the eight biological indicators less than the 25th percentile of the respective indicator value for Iowa coldwater streams	From five to six of the eight biological indicators less than the 25th percentile of the respective indicator value for Iowa coldwater streams	From seven to eight of the eight biological indicators less than the 25th percentile of the respective indicator value for Iowa coldwater streams
Rivers, streams, lakes & flood control reservoirs	Fish kill reports	No pollutant-caused fish kills during the most recent 3-year period	[category not used]	One pollutant-caused fish kill during the most recent 3-year period	More than one pollutant-caused fish kill during the most recent 3-year period

Table 6b (cont.)

FISH CONSUMPTION USES					
		Beneficial Use Fully Supported		**Beneficial Use Impaired**	
Type of Waterbody	**Source of Information**	**Fully Supported**	**Fully Supported/ Threatened**	**Partially Supporting**	**Not Supporting**
Streams, rivers, lakes, & flood control reservoirs	monitoring of levels of toxic contaminants in fish tissue	Levels of all toxics less than one-half the respective FDA action levels; waterbody is not covered by a fish consumption advisory	Level of at least one toxic is greater than one-half the respective FDA action level; waterbody is not covered by a fish consumption advisory	[category is not part of IDNR's consumption advisory protocol and is not used for listing purposes]	Levels of one or more toxics have exceeded respective FDA action levels in two consecutive samplings and a "no fish consumption" advisory is in effect for the general population
PRIMARY CONTACT RECREATION (SWIMMABLE) USES					
Streams, rivers, lakes, & flood control reservoirs	monthly monitoring data for fecal coliform bacteria	Geometric mean of fecal coliform samples # 200 orgs/ 100 ml and # 10% of samples > 400 orgs/ 100 ml.	[category not used]	Geometric mean of fecal coliform samples # 200 orgs/ 100 ml but > 10% of samples > 400 orgs/ 100 ml.	Geometric mean of fecal coliform samples > 200 orgs/ 100 ml.
Lake beaches	weekly monitoring data for fecal coliform bacteria	Geometric mean of at least 5 fecal coliform samples over a 30-day period # 200 orgs/ 100 ml.	[category not used]	[category not used]	Geometric mean of at least 5 fecal coliform samples over a 30-day period $ 200 orgs/ 100 ml.
Streams, rivers, lakes, & flood control reservoirs	closure of beaches and other swimming areas	No swimming area closures in effect during the biennial reporting period.	[category not used]	One swimming area closure of less than one week duration during the biennial reporting period.	More than one swimming area closure, or one swimming area closure of more than one week duration during the biennial period.

Table 6c (cont.)

DRINKING WATER USES					
		Beneficial Use Fully Supported		**Beneficial Use Impaired**	
Type of Waterbody	**Source of Information**	**Fully Supported**	**Fully Supported/ Threatened**	**Partially Supporting**	**Not Supporting**
Waterbodies designated for use as a source of potable water (=raw water source)	ambient monitoring data for toxics	All levels of toxic metals or pesticides are less than human health criteria (HHC) or maximum contaminant levels (MCLs)	Average levels of toxic metals or pesticides # HHC or MCL, but one or more samples > MCL.	[category not used]	Average level of toxic metals or pesticides greater than MCL.
Waterbodies designated for use as a source of potable water (=raw water source)	ambient monitoring data for nitrate	All levels of nitrate are less than U.S. EPA's maximum contaminant levels (MCLs).	No more than 15% of samples violate the MCL for nitrate. Or, trend analysis shows a significant increase in contaminant levels.*	From 15-25% of samples violate the MCL for nitrate and/or from 15-25% of samples violated the MCL for nitrate in the previous biennial reporting period.	More than 25% of samples exceed the MCL for nitrate and/or more than 25% of samples violated the MCL for nitrate in the previous biennial reporting period.
Municipal drinking water (=finished water)	public water supplies using surface waters	No drinking water supply closures or advisories in effect; water not treated beyond reasonable levels.	Some drinking water use restrictions have occurred and/or the potential for adverse impacts to source water quality exist.	One drinking water advisory lasting 30 days or less per year, or other problems not requiring closure but affecting treatment costs.	One or more drinking water supply advisory lasting more than 30 days per year, or one or more drinking water supply closures per year.

* Considered as candidates for Section 303(d) listing.

3.2.3. Organization of the 2002 303(d) List

Iowa's 303(d) list of impaired waterbodies is subdivided into five categories. These categories are as follows (IDNR 2002):

Part One: Waterbodies impaired by one or more "pollutant" for which TMDLs would be required to be established within 10-15 years. A "pollutant", as defined in 40 CFR Section 130.2, could be any of the following: dredged soil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt; also, sediments, pathogens, nutrients, metals, low dissolved oxygen, temperature, pH, pesticides, mercury, organics, ammonia, and industrial, municipal, and agricultural waste discharged into water.

Part Two: Waterbodies impaired by "pollution" but not impaired by one or more "pollutant" and which will not require a TMDL. "Pollution" is defined in 40 CFR Section 130.2 as "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of the water." Examples of "pollution" include habitat alterations, impaired biological communities and flow alterations.

Part Three: Impaired waterbodies for which TMDLs have been established but where water quality standards have not yet been attained.

Part Four: Impaired waterbodies for which the state can demonstrate that technology-based or other enforceable controls would attain water quality standards by the next listing cycle. Generally, TMDLs would not be required for waterbodies included in Part Four of the list; however, such waterbodies that do not achieve water quality standards by the next listing period could potentially be moved to Part One and a TMDL required. IDNR does not currently list any sites in Part Four, however, due to conflicts with Iowa's credible data law, which specifically bars the listing of waters where applicable water quality standards can be attained by existing technology-based effluent limits or other required pollution control measures.

Part Five: Waterbodies that are biologically impaired, but where no source or cause of impairment has been identified. Biological impairment is typically identified through biological monitoring of streams and rivers and through standardized assessments of lake recreational fisheries. Depending upon consistency with Iowa's "credible data" law, other types of biological monitoring may result in identification of a biological impairment without identifying a cause of the impairment. Identification of the cause(s) of impairment will precede movement of these waters to Parts One and Two of the list. Additional data collection and analysis is performed prior to the next reporting cycle to attempt to determine the cause of such impairments.

A 9-year schedule has been established for completing TMDL development for the 157 waterbodies listed on Iowa's 1998 Section 303(d) list (*SAILORS, Inc. et al. vs. the U.S. Environmental Protection Agency et al., 2001*). Table 7 presents a listing of the number of impaired waterbodies or waterbody segments requiring TMDL development each year of the 9 year period.

Table 7. TMDL Completion Schedule for Waters on Iowa's 1998 Section 303(d) List

Deadline	Number of waterbodies or segments requiring TMDLs
December 15, 2000	3 (specific waterbodies identified)
December 15, 2001	12 (specific waterbodies identified)
December 15, 2002	13 (specific waterbodies identified)
December 15, 2003	16
December 15, 2004	22
December 15, 2005	19
December 15, 2006	17
December 15, 2007	17
December 15, 2008	18
December 15, 2009	20

3.2.4. Prioritization Criteria

In addition to requiring a listing of impaired waters, Section 303(d) of the Clean Water Act also requires the establishment of a priority ranking system for those waters, which takes into account the severity of the pollution and the uses to be made of such waters. IDNR's prioritization is based on these required considerations as well as other factors, such as best professional judgement of IDNR staff, results of volunteer monitoring, and public comments. Meeting any one criterion in a priority category does not necessarily mean that the waterbody will be prioritized as such, since many waters fit criteria from multiple categories (IDNR 2002).

High Priority

- Waters where sufficient water quality information exists to understand and analyze causes and effects of the problems and opportunities are available to correct or substantially improve water quality;
- Waters with imminent human health or aquatic health problems;
- Waters with documented widespread local support for water quality improvement; or
- Waters where state or federally threatened or endangered species are impacted.

Medium Priority

- Waters where sufficient water quality information exists to understand and analyze causes and effects of the problems; however, opportunities are not immediately available to correct or substantially improve water quality; or
- Waters where local support for TMDL development is expected but not known.

Low Priority

- Waters where insufficient water quality information exists to understand and analyze causes and effects of the problems and limited opportunities are available, at this time, to correct or substantially improve water quality;
- Waters with no evident local support for water quality improvements.

4. SURFACE WATER MONITORING AND CLEAN WATER ACT SECTION 303(D) LISTING RECOMMENDATIONS

4.1. Monitoring Program Structure, Funding and Staffing

The major objectives of Iowa's surface water quality monitoring program are outlined in the body of the most recent Section 305(b) Report (IDNR 2001) and within a document entitled *Iowa Water Monitoring Plan 2000* (IDNR 2000) and are summarized in section 2.1 of this report. The monitoring objectives outlined in these documents range from resource characterization and protection to abatement and restoration of impaired waters and, thus, are appropriately comprehensive in scope for a state monitoring program and consistent with EPA Region 7's guiding principles for such a program. Current objectives and priorities for improving the monitoring program were partly formulated in 1999 and 2000 through a broad public participation process that featured the involvement of two groups: a Water Monitoring Advisory Task Force, composed largely of public stakeholders, and a Technical Advisory Committee, composed of professionals with backgrounds in monitoring. One of the results of this collaborative effort was *Iowa Water Monitoring Plan 2000* (IDNR 2000) which identifies deficiencies in the monitoring program that should receive prioritization for future funding and outlines funding levels needed to enact priority recommendations. A failing of this document is that it lacks a clearly articulated time-line or schedule for requesting funding and enacting program recommendations.

In addition to the data derived from their own monitoring activities, IDNR makes effective use of data collected by other agencies and organizations, which include the USGS, USACE, EPA and neighboring state environmental agencies. IDNR also uses data collected by municipalities, industry, volunteers and data collected as part of special projects. Verification that data provided by cooperating institutions were collected in accordance with a scientifically defensible sampling and analysis plan and appropriate QA/QC procedures is required before that data can be used for listing purposes, as specified in Iowa's Credible Data Law. IDNR has attempted to take these diverse monitoring networks into account in the design of their fixed station network to avoid duplication of effort. Coordination of sampling efforts between the different monitoring programs is also one of the mandates to the Water Monitoring Advisory Task Force.

Due to the requirements of Iowa's Credible Data Law, most volunteer monitoring conducted in the state of Iowa is not considered sufficiently "credible" to be used for listing purposes. The biggest obstacle to use of a higher percentage of volunteer data appears to be the stipulation that "credible data" must be supported by an IDNR-approved sampling and analysis plan and include appropriate quality assurance and quality control procedures. A secondary obstacle identified by IDNR is the existence of unexplained and presumably nonrepresentative variations in water quality data reported by volunteers. Since volunteer monitoring has significant potential to stretch limited funds and expand monitoring coverage, IDNR should consider expanding the level of training provided to some volunteers beyond the current two levels to overcome the first obstacle. Such upgrades in the training offered to Iowa volunteers are currently under consideration by IDNR. Improved quality assurance and quality control procedures resulting from such training will also likely reduce observed variations in volunteer-collected data. If data variability problems persist following training upgrades, IDNR should take steps to identify and

eliminate the source of the referenced variability. Use of volunteer data by some other states for quantitative assessments demonstrate that such sample collection problems are not insurmountable.

IDNR is currently receiving annual appropriations from the state on the order of 2.5 million dollars to fund the water monitoring program. This funding level represents a substantial increase over that provided prior to 2000 and has allowed IDNR to upgrade the level of monitoring being performed in the state. However, this funding level is still far short of the 6 to 8 million dollars that IDNR independently estimated was needed on an annual basis to fully assess impacts at all spatial scales to its water resources. Yearly increases in funding that are targeted toward addressing deficiencies identified in the *Iowa Water Monitoring Plan 2000* (IDNR 2000) would help to close this funding gap. While the Iowa state legislature has increased funding for the ambient surface and groundwater monitoring programs in the last few years, these increases have, to some extent, been offset by budget cuts to other agencies and programs. As examples, a cooperative program between the IDNR and USGS that supported gaging stations (both discharge and sediment) and Iowa's groundwater level and water quality network went unfunded in the most recent fiscal year ($250,000 in funding was provided to this program in 2000). Because this cooperative program represented a significant complement to IDNR's Ambient Water Monitoring Program, supporting the bulk of the ambient groundwater network and providing invaluable flow data for the ambient surface water network, fund losses were replaced with funds from the Ambient Water Monitoring Program. The Ambient Monitoring Program also picked up the cost of 5 sediment gaging stations ($50,000) in FY2002 because of lost funding by other agencies and programs. From FY2000 through 2002, the Ambient Program also covered the cost of 7 additional U.S. Geological Survey gages, at an annual cost of $42,130.

Staffing for the water monitoring program (9 FTE) is currently funded through EPA 106 grants, since state appropriated monitoring funds are prohibited from being used for department personnel. Staffing limitations have partly been addressed by the partnering of staff from the Water Monitoring Section of the Iowa Geological Survey Bureau (IGSB) with existing IDNR water quality staff to form a more functional and effective water monitoring and assessment group.

4.2. Data Management, Analysis, and Reporting

IDNR currently stores water quality data from their ambient monitoring program in an updated version of the STORET database system and annually uploads that data to the EPA's STORET system. Data stored in the Iowa system is internet-accessible, which allows the public to have access to the data. IDNR has also been systematically migrating historic data into the STORET database. This approach to data management for the ambient water quality data is entirely consistent with EPA recommendations. However, a failing of the current data management approach is that only IDNR-generated ambient data is being actively entered into STORET, while other data used for making use support determinations that come from various cooperating agencies and programs is managed separately, typically in isolated Excel files. (USGS data is internet accessible on the NWISweb.) The lack of a consistent and comprehensive approach to data management complicates data analysis and manipulation and makes it difficult to identify all

data used in making resource assessments and use support judgements. For the ambient monitoring data that is managed in STORET, retrieval of large volumes of data, complex queries, or repeated retrievals can be cumbersome, especially to novice users.

To date, data synthesis and analysis has been a lesser priority relative to actual production of data and the placing of that data in a form accessible to the public. The need for U.S. EPA to restore data analysis capabilities to the STORET system is becoming critical as the state attempts to deal with issues such as nutrient criteria, TMDL development, and the emphasis on numeric water quality standards. As the volume of volunteer monitoring data continues to increase, public pressure to incorporate that data into statewide assessments of water quality will also increase.

Data base tools for organizing, plotting, querying, etc. are needed by the TMDL program and other programs. These tools should feed smoothly into statistical analysis packages, GIS layers, and models and be able to acquire data directly from STORET. Various scales of land use and land cover data in GIS coverages will be needed for watershed level and statewide analyses for a variety of issues. NRCS development of Iowa SSURGO soils information is needed for dependable watershed modeling and as an aid to the TMDL program. Valuable IDNR resources are and will be used to convert existing county soil maps into SSURGO-like information for modeling. Additionally, digitized FSA and land use cropping practice info would be beneficial for watershed analysis.

Plans and methods are currently evolving to address some of these data management issues. To allow better management and provide better access to all monitoring data, IDNR is working toward coordinating direct data entry into STORET with cooperating agencies and programs who provide outside sources of monitoring data (IDNR 2000). This process of consolidating monitoring data should continue and be expanded. IDNR should continue to develop data retrieval applications and web-based data management tools. A data warehousing structure should be developed to facilitate faster data retrieval and to facilitate the saving of queries. Much of the responsibility for improving the data management abilities of STORET and working toward developing additional capabilities within the database rests with EPA.

EPA's Office of Water is encouraging states and cooperating agencies to georeference all waterbody information to National Hydrography Dataset (NHD) reaches or, where NHD georeferencing is not possible, to provide locations of waterbodies using latitude and longitude. Georeferencing of Iowa waterbodies to NHD would facilitate the management of the collected data and IDNR is encouraged to move toward comprehensive georeferencing of Iowa's waterbodies in NHD.

4.3. Spatial Coverage of Sampling

As was previously detailed in Section 2.2.4, the GIS analysis of the spatial coverage of Iowa's surface water quality monitoring program indicates that, at the major basin level, sample distribution is reasonably proportionate to the relative size of the watershed (see Table 2). Reasonable spatial coverage also appears to have been attained at the 8-digit HUC watershed level (see Figure 9).

Review of sample distribution relative to listed waters shows a similar proportionate relationship, with 32% of all sampling sites being found on listed waters, while listed waters comprise 29.8% of all waters assessed. This proportionate relationship shows a general lack of bias in the selection of sampling sites in Iowa.

The foregoing relationships indicate that Iowa's monitoring strategy and network design have been well thought out and designed to maximize coverage given obvious program funding constraints. This effective utilization of available funds does not completely compensate for other deficiencies in spatial coverage, however.

Iowa has 47,603 acres of publicly-owned lakes (out of a total of 92,816 acres) with designated beneficial uses and 40,850 acres of flood control reservoirs (IDNR 2001). From an acreage perspective, 90% of publicly-owned lakes and 100% of reservoirs are regularly assessed for support of beneficial uses. Assessment of support of uses of Iowa's rivers and streams is much lower than that attained for lakes and reservoirs, however, with only 6,390 river and streams miles being routinely assessed of the 12,186 miles with designated beneficial uses (52%) (IDNR 2001). The foregoing statistics are based upon mileage (rivers) and acreage (lakes) and an even bigger disparity exists between "designated" and "assessed" if actual numbers of waterbodies is examined. With regard to rivers, 392 river and stream segments are currently assessed out of 1068 with designated beneficial uses (37%) while 136 lakes are assessed out of 279 with designated beneficial uses (49%) (IDNR, 2001). Iowa has 27,273 acres of wetlands with designated beneficial uses (out of 50,271 acres) (IDNR, 2001). Prior to 2000, support of designated beneficial uses for wetlands was based upon best professional judgement, with 57% of the 34,330 acres assessed being classified as impaired (IDNR, 2001). Following enactment of the "Credible Data Law" in 2000, Section 303(d) listings of Iowa's wetlands has effectively ceased due to "best professional judgement" no longer being accepted as an adequate basis for identifying impairment.

Table 8. Estimated Total Size of Waterbodies in Iowa, with Size Designated for Beneficial Use and Size Actually Assessed (IDNR 2001). Values in parentheses represent number of specified waterbodies.

Waterbody Type	**Estimated Total Size in State**	**Size Designated for Beneficial Use**	**Size Assessed for Support of Use**
Rivers/streams (miles)	71,665	12,186 (1,068)	6,390 (392)
Publicly-owned Lakes (acres)	92,816	47,603 (279)	43,268 (136)
Flood Control Reservoirs (acres)	40,850 (4)	40,850 (4)	40,850 (4)
Publicly-owned Wetlands (acres)	50,271	27,273 (88)	-

Improvements necessary to adequately assess state lakes and wetlands are specifically discussed

and addressed in a later section of this report. With regard to the assessment of rivers and streams, the relatively low percentage of those river and stream segments with designated uses being routinely assessed is a significant current deficiency in Iowa's monitoring program and one that should be addressed. IDNR's recent initiation of a four-year probabilistic survey of the state's stream resources will likely help with the assessment of general water quality within the ecoregions and will facilitate identification of areas of impairment but sampling frequency is inadequate for listing purposes. The sheer number of rivers and streams lacking assessment in any current form also renders a probabilistic approach inadequate, in and of itself, for addressing this sampling deficiency. While any significant effort to address this deficiency will likely require the commitment of additional state resources, the most cost-effective approach for resolving this deficiency will be the development of a well-designed rotating basin sampling program. A rotating basin approach provides a hydrologic framework to cost-effectively focus resources on specific basins while allowing comprehensive assessment of all watersheds or basins over a 3-5 year period. The cyclic monitoring process will also facilitate trend analysis and assessment of implemented management strategies. IDNR should begin assessing design and funding options for such a system, given the lack of reasonable alternatives due to funding constraints and IDNR's reasonable interest in retaining current fixed monitoring stations with historic data sets.

In addition to the noted deficiency in the comprehensive assessment of all rivers and streams with designated beneficial uses, adequate spatial coverage is also lacking at the smaller watershed scales (see Figure 10) and this area of weakness also warrants some consideration. Although significant improvements in this aspect of the monitoring program is likely beyond the funding ability of an IDNR-directed project, it could be the subject of a volunteer monitoring program initiative. That possibility should be thoroughly explored by IDNR.

4.4. Sampling Parameters (Core and Supplemental Water Quality Indicators)

Because of the funding limitations imposed on most state monitoring programs, EPA recommends use of a tiered sampling approach that would maximize parameter coverage and would include a core set of baseline indicators to represent each applicable designated use, plus supplemental indicators that would be selected according to site-specific or project-specific decision criteria (USEPA 2003). Parameters targeted for sampling in Iowa waterbodies varies by waterbody type and sampling program and, in most cases, appear to be appropriately designed to reflect differences in designated beneficial use. This sampling approach is generally consistent with EPA's recommendation for the establishment of core water quality indicators.

One exception to the foregoing characterization that IDNR's sampling parameters adequately characterize designated beneficial uses involves aquatic life criteria. In some cases, parameters used to make use support determinations for aquatic life do not appear to be sufficiently comprehensive to allow a thorough determination to be made. Specifically, organic enrichment, nutrients, and siltation have been identified as the most commonly identified causes of water quality impairments in Iowa, with phosphorus being specifically singled out as the most common nutrient controlling plant growth (IDNR 2001). While data on dissolved orthophosphate as phosphorous and total phosphorus are routinely collected by IDNR, this data is not currently used for assessing use support; likely, in large part, due to a lack of state criteria for identifying

impairment. Trophic state index (TSI), which utilizes chlorophyll-a, total phosphorus, and transparency to estimate the biomass of suspended algae in a lake, is currently being used to assess use support in the state's publicly-owned lakes. While this indicator provides some assessment of nutrient impairment in lakes, it generally recognizes only overwhelming evidence of impairment and, therefore, does not provide a complete substitute for direct numeric nutrient criteria. State criteria are similarly lacking for assessing impairment resulting from siltation and such assessments are further complicated by a lack of adequate sampling parameters for measuring siltation. To address these deficiencies, IDNR should reevaluate its assessment protocols and standards for nutrients and siltation in light of EPA's recent recommendations in this area (USEPA 2000).

Other parameters that were identified as desirable additions to IDNR's surface water monitoring program, as resources become available, include the following:

- Fish tissue at the current urban stream locations, plus some additional urban locations;
- Metals at all the ambient sites (quarterly) to make Aquatic Life Use Support decisions;
- Persistent Bioaccumulative Toxics (PBTs) in water, sediment and fish tissue at a subset of all ambient sites; such toxics would include mercury, arsenic, pesticides and their degradates, antibiotics, and PAHs (at coal tar sites);
- Periphyton at stream reference sites;
- cyanobacteria, viruses and parasites at public beaches.

While core indicators have been established by IDNR to evaluate use support for all designated beneficial uses, IDNR does not appear to follow any consistent approach for the identification and establishment of supplemental water quality indicators. Additional parameters that appear comparable to such supplemental indicators have been targeted for collection in select situations. One such example is testing for a variety of pharmaceuticals, industrial chemicals, and insecticides being completed at monitoring stations located upstream/downstream of 10 major cities (IDNR 2002). To extend their monitoring capabilities, IDNR should consider establishing a process for identifying supplemental water quality indicators that would be monitored when there is a reasonable expectation that a specific pollutant may be present in a watershed, when core indicators indicate impairment, or to support a special study such as screening for potential pollutants of concern. Since supplemental indicators are particularly useful for identifying causes and sources of impairment, they could help IDNR resolve questions about outstanding undefined impairments.

4.5. Temporal Coverage

Monitoring station sampling frequency in Iowa varies somewhat depending on the type of sampling being conducted and the institution or agency performing the sampling. Sampling conducted on Iowa rivers as part of IDNR's ambient monitoring program was recently upgraded to monthly for all 62 sites as was IDNR's monitoring of stations upstream and downstream of major cities. Much of the data collected by cooperating agencies and groups such as USGS, USACE, Syngenta, Rathbun Lake Watershed Alliance, etc. are also collected on a monthly or greater frequency. State-owned beaches are sampled on a weekly frequency in the summer months. Sampling currently performed as part of the ISU-IDNR Lake Study is collected at a

sampling frequency of 3 times per year. Sampling frequency for biocriteria is currently not precisely defined but is intended to be repeated on about a 5 year rotation.

While sample data sets composed of 30 or more samples are typically recommended where statistical tests are used, in order to have good power for detecting exceedences (USEPA 2002), the sampling frequency employed by IDNR and cooperating agencies for most data collection efforts appear suitable for assessing ambient conditions and, in general, is adequate to define level of use support. Exceptions to this general statement include the following areas.

Iowa river reaches and the non-beach areas of some lakes designated for primary contact recreational uses are sampled once to twice a month as part of the state's ambient monitoring program. This monitoring frequency fails to produce the amount of data needed using EPA recommended assessment methodologies (IDNR 2002). IDNR's approach for assessing use support in these cases is to compare the geometric mean of a minimum of 10 samples collected over one or both recreational seasons to the state fecal coliform water quality standard, verification that no more than 10% of samples exceeded an EPA recommended single sample maximum allowable fecal coliform density of 400 organisms per 100 ml, and verification that no swimming area closures were issued during the two-year assessment period. This approach, while not entirely consistent with EPA recommendations, produces a smaller false positive rate (.30) than would EPA's methodology if used on such a limited data set (IDNR 2002).

With regard to lake beaches, single-sample maximum values are not used by IDNR as part of the criterion for assessing impairment because the standard 10% critical value would be exceeded by one exceedence for data sets of less than 10 samples, which would result in a high probability of incorrectly concluding that an impairment exists (IDNR 2002). This high false positive rate is a direct result of a less than optimal sampling frequency.

Sampling being conducted as part of the state's Lake Study has generally not yielded sufficient data, to date, for establishing impairment, because Iowa's 303(d) listing methodology requires that the combined data from at least three years of monitoring be used to establish impairment from this type of lake study (IDNR 2002b). During the current listing cycle, IDNR has been able to use TSI to identify lakes with overwhelming evidence of impairment for addition to the Section 303(d) list. Since the three year data minimum will be met in future listing cycles, sufficient data to assess impairment using standard data will then be available from this study. The sampling strategy employed for this lake study should be reevaluated to ensure that frequency and the restriction of data collection to summer months is sufficient to adequately evaluate seasonal variability and use support. Biocriteria sampling is currently very sporadic but this sampling approach is still in a state of evolution and standard statistical tests are apparently not being applied to the resulting data.

One limitation of the current IDNR sampling approach with regard to sampling frequency is that the program has traditionally focused on assessing ambient conditions to the exclusion of more episodic events such as storms. Nonpoint source pollutant concentrations in streams can increase dramatically as a result of storm-induced increases in runoff and a program focused exclusively on ambient conditions would likely miss such spikes in pollutant concentrations. Furthermore, event sampling for such runoff driven contaminants as sediment, pathogens, and phosphorus is

crucial for the development of effective TMDLs. IDNR has recently taken steps to partly fill this data gap by targeting select stations (one in each ecological region, for a total of 7) for sampling during runoff events. IDNR should consider developing a plan for expanding this event sampling effort by identifying additional locations to provide a coverage of a broader range of runoff and nonpoint source conditions.

4.6. Other Gaps and Deficiencies in the Monitoring Program

This section identifies gaps and deficiencies in IDNR's surface water monitoring program not detailed in the foregoing sections. The monitoring gaps and deficiencies listed here are based, in part, on gaps and deficiencies identified by a joint EPA/IDNR work group that recently completed an evaluation of Iowa's ambient water quality monitoring program. Possible responses to highlighted gaps and deficiencies referenced in this section were developed in coordination with the IDNR.

Comprehensive Coverage of Wetlands

The state of Iowa has thousands of acres of both public and privately-owned wetlands which can be categorized as permanent, semi-permanent, temporary, and seasonal. While no definitive inventory of all of Iowa's wetland resources currently exists, over 27,000 acres of Iowa's publicly-owned wetlands have been classified by IDNR as having an aquatic life designated beneficial use (IDNR 2001). Water quality monitoring of Iowa's publicly-owned wetlands is not routinely conducted by IDNR nor any other agency, however. Historically, IDNR has based assessments of an individual wetland's support of aquatic life uses on the best professional judgement of biologists within IDNR's Wildlife Bureau (IDNR 2001). However, with the enactment of Iowa's "credible data" law in 2000, best professional judgment was specifically barred from use in making use support determinations. As a result, the "credible data" law has created a sizable gap in the state's assessment efforts when it comes to wetlands.

This data deficiency is recognized by IDNR and that agency is committed to taking a series of coordinated strategic steps toward addressing this data gap in their surface water monitoring program. These "steps", in the form of a series of pilot projects, are designed to provide a scalable (to the ecoregion and state levels), holistic (both biological and chemical) and effective monitoring and assessment program for all of Iowa's wetlands. These strategic steps and projects will be coordinated, documented and linked through this Strategic Monitoring Plan and will include, but not be limited to, the following 1) a "Color Infrared Digital Orthography Project" to identify and inventory all of Iowa's wetlands (permanent, semi-permanent and temporary), 2) establishment of a wetlands technical advisory committee to help define appropriate monitoring protocol and assessment methodologies, 3) a R-EMAP pilot project for probability-based wetlands monitoring to assess baseline biological and chemical conditions, 4) a wetlands biological indicator development project (similar to Iowa's existing stream biocriteria development program), and 5) a reference site development and testing program. Funding for the linked projects will be sought through appropriate channels and sources such as Clean Water Act Section 104 or 106 appropriations. Other actions being contemplated by IDNR to address this deficiency include: an evaluation of the ability of existing functional models to provide information on the relative quality of individual (specific) wetlands and an evaluation of the

methods used by other states to assess whether wetlands meet water quality standards and the potential relevance of those standards for assessing Iowa wetlands (IDNR 2002).

The ultimate goal of developing this wetland monitoring program is to positively affect the quantity and quality of data and information available for the effective protection and management of all of Iowa's wetland resources by enabling the following activities:

1) The development of a wetland monitoring and assessment methodology to be used by the Iowa Department of Natural Resources to conduct wetland monitoring as part of the state's ambient water quality monitoring program;
2) A periodic assessment (status and trends) of the condition and stressors of Iowa's wetlands;
3) An assessment of the effectiveness of wetlands toward meeting nutrient management goals;
4) The setting of appropriate water quality and biological standards for wetlands protection;
5) Reporting of wetland conditions to the citizens of Iowa.

Comprehensive Coverage of Large "Border" Rivers

Iowa has only a limited monitoring presence on the state's large border rivers which consist of approximately 660 miles of the Upper Mississippi and Missouri rivers. Iowa DNR staff conduct routine water quality monitoring on the Mississippi River and several Iowa tributaries as part of the USGS Long-Term Resource Monitoring Program. IDNR does not, however, conduct water quality monitoring on the Iowa reach of the Missouri River. This monitoring deficiency is due, in part, to budget constraints, but is also partly grounded in IDNR's stated belief that monitoring of large rivers that border individual states should be federally directed and not a state responsibility. The decision not to monitor these border rivers as part of the IDNR's enhanced water quality monitoring program was also based on input from both citizen and technical advisory committees, which felt that Iowa's monitoring resources should not be devoted to monitoring of interstate rivers.

Even though Iowa does not conduct their own monitoring on the Mississippi River, IDNR has reviewed data collected through the Long Term Resource Monitoring Program (LTRMP) with the intent to use that data in their 305(b) assessment. However, IDNR's review of the LTRMP data found it to be of limited utility. The focus of the LTRMP program has been on data collection rather than both data collection and analysis. Further, the data collected under the LTRMP program specifically targets factors that affect aquatic life and aquatic habitat trends, but biocriteria for use in establishing impairment of large rivers have yet to be developed and the state has struggled to find a suitable method of using the data for determining use impairment. The LTRMP data is also limited in that it is restricted to Pools 4, 8, 13, 26, La Grange Pool of the Illinois River and the Open River Reach miles 29-80 of the Mississippi River. Available guidance provides little to no direction on how such isolated data could be used to evaluate impairment of other pools or segments of the river (i.e. if two Mississippi River pools show apparent impairment, it does not necessarily follow that the intervening river segment or pool(s) are also impaired). This sampling program, which is administered by USGS and contracted through the IDNR, has also suffered significant cuts in funding in FY03 and these cuts will further hamper the state's ability to monitor and assess conditions on the Upper Mississippi.

To partly address this monitoring deficiency, IDNR is committed to developing and executing, in cooperation with EPA Region 7 and EPA's Office of Research and Development, the EMAP - Central Basin project (EMAP-CB), which is scheduled to begin sampling as early as 2004. EMAP-CB will attempt to develop the necessary tools (including indicators and sampling techniques) and partnerships to institute a probability based monitoring project aimed at assessing baseline biological, chemical and habitat conditions for the Missouri and Mississippi Rivers. Cooperative regional monitoring agreements between the Upper Mississippi River states and federal agencies such as the USGS could also help bridge this monitoring gap and should be pursued. The level of success of those attempts will likely depend upon the availability of matching funds with cooperating states and federal agencies.

While the EMAP project is a good starting point and will likely allow development of key tools and indicators, it is currently unclear whether the scale and frequency of sampling within this probability-based monitoring project would be sufficient to target all discrete larger border river segments for monitoring and assessment. All river segments with designated beneficial uses will ultimately need to be targeted for monitoring and assessment to completely resolve this program deficiency.

Federal guidance is also needed to establish/promote methods for assessing impairment in large rivers such as the Mississippi, to identify the types of data that would be most useful for establishing impairment, and to outline appropriate methods for using data collected from widely separated points in assessing impairment of larger river segments (as appropriate).

Trend analysis is an example of a method commonly used in the Mississippi River pools to assess changes to aquatic life but states have not traditionally used this type of data for establishing impairment and, therefore, use of such data for 303(d) listing purposes will also require direction on how trend analysis is best used for that purpose.

Beyond federal input, regional agreement must also be reached among the states on what parameters in big rivers should be monitored and what benchmark(s) should be used for establishing impairment. Such agreement is crucial for border rivers that separate states and that will require the cooperation of two or more states to alleviate any impairments.

Non-significant Public and Private Lakes (including Ponds)

Iowa has three general categories for lakes it considers within the purview of its monitoring program: significant public, non-significant public and private with public access. The state currently does not consider private lakes without public access to be within its purview. Significant public lakes are defined as: 1) principally maintained for public use, 2) have a minimum surface area of 10 acres, 3) are capable of supporting fish stocks of at least 200 lbs/acre, 4) have a watershed to lake surface area ratio of less than 200:1, and 5) are not shallow marsh-like lakes, federal flood control impoundments, or used solely as water supply reservoirs. Non-significant public lakes carry essentially the same definition except they are smaller than 10 acres or are used primarily as water supply reservoirs. The definition of private lakes with public access is self-explanatory. All publicly owned lakes have water quality standards defined within the Iowa Administrative Code. The existence of water quality standards for privately-owned lakes with public access depends on the beneficial uses designated for the stream or river

impounded to form the lake. Typically, privately-owned lakes receive the same level of protection as does the stream either entering or leaving the lake.

While the IDNR surface water monitoring program currently actively surveys all significant public lakes, reservoirs and state-owned beaches through a census design, only 17 of the 164 non-significant public lakes and none of the 12 or so private lakes with public access are sampled. Furthermore, sampling of the non-significant public lakes appears to be achieved using a targeted design which does not represent the entire population. Inventories of the non-significant public lakes and private lakes with public access categories appear to be either incomplete or in need of updating.

IDNR has committed to evaluating the distribution of these lakes and developing an appropriate monitoring design. The inventories of private lakes with public access and non-significant public lakes will also be reviewed and updated, as appropriate. A GIS overlay of these lakes may also be developed.

Given the relatively small size of the population of non-significant public lakes and private lakes with public access, overlaying and implementing a probability-based design could be relatively easily accomplished, given the state's expertise with other probability-based projects, and would provide reasonably comprehensive coverage with a known degree of scientific confidence. However, a complete inventory of these lakes would first need to be completed. In addition, if biological end points were needed to make assessments relative to state water quality standards, then a process for developing biological indicators and reference sites would need to be established. This latter process, if needed, would constitute a significant investment in both resources and expertise.

Intermittent Streams

The state of Iowa has an estimated 43,000 miles of intermittent streams but conducts only limited monitoring on those streams. Intermittent streams are undoubtedly an important aquatic ecological resource and techniques for assessing the condition of such streams should be further developed by IDNR in the future.

One potential option for addressing the lack of intermittent stream data could be the training of participants in Iowa's volunteer monitoring program (IOWATER) to conduct screening level assessments on intermittent streams. Viability of such an approach would be dependent upon both the development of bioassessment tools designed to determine the ecological health of intermittent streams and the ability of IDNR to "upgrade" the training of volunteers to the level of being capable of collecting data in accordance with a sampling and analysis plan with appropriate QA/QC procedures.

More in-depth assessment using bioassessment tools and extensive water chemistry analyses is likely currently beyond the scope of IDNR's monitoring program, given current demand on resources and the existence of higher priority monitoring issues.

Precipitation/Air Deposition

Impacts to surface waterbodies resulting from precipitation or air deposition of pollutants such as nutrients, pesticides, and antibiotics is a significant but unquantified concern in Iowa due to a lack of monitoring.

EPA Region 7 has identified a need for an air deposition monitoring network for the Region and will attempt to coordinate the development of such a network with the individual states within the region and the air monitoring program. As an initial step in the development of such a network, a pilot project developed in partnership with the states is envisioned that could be funded with R-EMAP or air program funds.

The USGS currently operates two wet/dry deposition monitoring stations within the state of Iowa and IDNR is committed to working to ensure the continuity of these stations. IDNR also intends to explore cooperative efforts with the USGS and other federal agencies to expand the limited existing network to include additional stations in critical watersheds. Partnerships with the Air Quality Bureau of IDNR could also be pursued to build upon existing air compliance monitoring by adding wet/dry deposition equipment.

Stream Gaging Data & Stations

Stream flow measurements are a necessary component of many of the Department's water quality activities including NPDES permits, TMDL development, floodplain permits, and water quality modeling. Stream gaging has traditionally been administered through cooperative agreements with the USGS but this program has suffered funding cuts at both the state and federal level over the past decade. Continuous stream gaging at smaller stream sites is largely nonexistent at the current time and the lack of such stream flow measurement data negatively impacts TMDL development on listed streams.

IDNR has ranked the existing gaging stations relative to their value to the various water quality programs and their potential for being funded through partnerships with various governmental agencies (municipalities, counties, DOT, USDA, etc.). IDNR also intends to establish a prioritized list of potential new gaging sites that will be submitted to partner agencies for proposed funding. IDNR also continues to work with the USGS to request new gaging stations under the National Stream Information Program (NSIP). IDNR also intends to pursue new funding partnerships and will attempt to get State General Fund appropriations restored to former levels by alerting the legislature to the threat that a lack of stream gaging data poses to many of the state's water quality programs.

Biological Indicators and Reference Conditions for Assessing Lake Health

The development of adequate lake water quality standards for such parameters as N, P, and chlorophyll a is directly dependant upon the existence of a monitoring system capable of defining reference conditions and corresponding deviations. TMDL development also depends upon the existence of adequate monitoring data from lakes and tributaries. IDNR currently conducts census-type sampling on its significant public lakes but lake assessments are hampered by the following factors:

1) lack of biological indicators calibrated for Iowa lakes;

2) lack of reference conditions developed for Iowa lakes;
3) concerns about the spatial and seasonal representativeness of sample collection strategy;
4) detection level for total P needs to be appropriate for the development of standards;
5) flow measurements and event sampling on contributing streams needs to be adequate to validate load calculations;
6) accurate lake modeling may require continuous tributary flow monitoring, continuous discharge monitoring, and bathymetry for some sites;
7) fisheries and biological assessments are needed as a basis for determining if TMDL targets are being achieved; monitoring and modeling need to provide the connection between the assessment and the water quality problem indicator (sediment, P, N, chlor a, etc.);
8) sediment coring is needed to provide deposition history and an understanding of how sediment nutrients are recycled in the water column.

On the issue of biological indicators, IDNR will proceed with indicator development in cooperation with the Iowa technical committee and will take into account what other states have done. Current efforts to develop a lake classification system and mesh that system with lakes richness data collected by the IDNR fisheries section may also support development of biological criteria. The state TMDL program is currently contracting with the USGS to collect bathymetry and sediment coring.

Validation and Refinement of Biological Indices to Appropriate Eco-region Scales

IDNR has been actively developing biological criteria for fish and macroinvertebrates for a number of years to facilitate making aquatic life use support determinations. At present, however, these biological criteria require further refinement and validation before they can be used to making meaningful assessments. In particular, the linkages between biological parameters, habitat and water chemistry must be more thoroughly documented to support the biological criteria program.

IDNR plans to continuously improve their biological criteria through the routine collection of data from their enhanced monitoring network and are also considering the use of multi-variate approaches to strengthen their bioassessments, such as correlating habitat measures such as sediment and channel morphology to these indices.

Characterization of Reference Conditions for all Resource Classes but especially Large (non-wadeable) Streams

In order to properly assess the condition and degree of impairment of the state's water resources, appropriate reference sites must be identified and used in the assessment process. In Iowa, as in many other states dominated by agriculture, this task is made more difficult by the general deficit of undisturbed sites. This problem is especially acute for the large non-wadeable streams, particularly those interior streams crossing eco-region boundaries.

Identification of new sites with potential as reference sites may be facilitated by the R-EMAP projects for wadeable streams and wetlands. For the larger non-wadeable streams, the following activities may help locate undisturbed reaches: use of GIS tools to isolate point and non-point sources, identification of land use and land cover types expected to minimize impact, and review

of observations and recommendations made by field agents regarding new sites and watersheds that could potentially be useable as reference sites. Other possible strategies for assessing non-wadeable streams include: adaptation and application of wadeable stream methods, such as use of artificial substrates, to non-wadeable streams and tasking CPCB to synthesize information on tools and indices being used by other states in the Midwest for assessing non-wadeable streams. With regard to chemical criteria, IDNR is working with the RTAG work group to develop draft nutrient criteria for lakes and streams.

City and County-owned Beaches

The state of Iowa has an indeterminate number of city and county-owned beaches where the frequency and quality of monitoring is unknown. Furthermore, the development of any approach to deal with this data gap is complicated by the fact that responsibility for the monitoring of city and county-owned beaches is currently unresolved.

IDNR has committed to the development of an inventory of city and county-owned beaches and will provide assistance to local organizations in the development of monitoring programs for those beaches. However, IDNR intends to defer beach closure decisions to those local organizations.

Adding Historical Biological Record to Assessments

Over the course of its settlement history, the state of Iowa has suffered significant losses to its aquatic biological resources, both in terms of diversity and number. Addition of a historical component to the state's aquatic assessments estimating the degree and impact of this historical biota loss would be beneficial. One approach for addressing this issue would be to use grant money to fund a graduate student to compile a report summarizing Iowa's historical aquatic biological resources.

4.7. 2002 Section 303(d) Listing Methodology

The Section 303(d) listing methodology currently being followed by IDNR, as summarized in the document entitled *Methodology for Developing Iowa's 2002 Section 303(d) List of Impaired Waters* (IDNR 2002), includes the basic program elements required by 40 CFR 130.7 and generally conforms to recommendations outlined in the various applicable EPA guidance documents (USEPA, 1991, 1993, 1997, 2003). IDNR classifies data reliability as required and qualified data are compared to water quality standards to make use support determinations. In assessing use attainment, IDNR typically uses an ideal standard or criterion based upon a maximum, an average, or a percentile; which is generally consistent with EPA recommendations. However, EPA also recommends statistical verification that the standard or criterion has been attained through use of an appropriate statistical test (USEPA 2002). The specific statistical methods used by IDNR to verify standard attainment is not clearly elucidated in the IDNR documents reviewed for this report and cannot be commented upon for this interim report.

While basic requirements are being met by IDNR's listing methodology, the following specific discrepancies were noted between IDNR's approach and federal recommendations/requirements:

Iowa's Credible Data Law

Iowa's "credible data law" specifically exempts waterbodies assessed as being impaired from inclusion on the Section 303(d) list when existing technology-based limits or other required pollution control measures are adequate to achieve applicable water quality standards. Impaired waterbodies are also exempt from listing where failure to attain water quality standards is solely the result of violations of NPDES program permits or stormwater permits and the enforcement of the pollution control measures is required. These waterbodies apparently remain exempt even when impairment continues to exist at the next listing cycle (IDNR 2002). Exemption of such cases from the Section 303(d) list appears to be inconsistent with federal guidelines which dictate that such pollution control requirements "must be established and enforced by Federal, state, or local laws or regulations and be stringent enough that, when applied, the receiving water body will meet water quality standards"(USEPA 1991). The continued existence of impaired conditions from one listing cycle to another would appear to violate this standard and implies either that the approved effluent standard is not sufficiently stringent or the standard is not being adequately enforced. An exception to this general statement would be cases where the compliance schedule contained within the permit extended beyond the next listing cycle.

Waters in Need of Further Investigation

According to Iowa's credible data law, waterbodies where an assessment indicates a potential impairment, but where the assessment lacks "credible data" are to be placed on a list of "waters needing further investigation"(IDNR 2002). Such waterbodies include: publicly-owned lakes added to the 1998 303(d) list based upon "best professional judgement" which are currently monitored but have not been assessed in 2002 as being impaired, publicly-owned wetlands placed on the 1998 303(d) list on the basis of "best professional judgement" and for which appropriate monitoring programs and assessment criteria have yet to be developed, and river and stream segments where monitoring has indicated a potential impairment but data does not currently meet quantity or quality requirements (IDNR 2002). IDNR recognizes that follow-up monitoring is required in these cases and collection of this additional information is required prior to the next listing cycle. With the exception of the lakes program, however, no clear mechanism for targeting, tracking and completing this additional data collection appears to be in place. On that basis, there appears to be a need for the establishment of a formal "special studies" process to which such potentially impaired waterbodies with an unknown cause of impairment could be routed.

4.8. TMDL Development and Monitoring Recommendations

Cross-program Coordination

Cross-program coordination needs to be enhanced between the ambient monitoring program and the TMDL program, particularly with regard to the implementation of monitoring plans on major interior river basins and in the meeting of monitoring commitments for phased TMDLs.

Monitoring plans have been developed and are in the process of being implemented on the Cedar and Big Sioux Rivers. Such monitoring programs are typically dynamic and require periodic modification but adequate resources are not currently available to continually assess

accumulating flow and sampling data, to inventory pollutant sources, and correlate monitoring data to watershed hydrology and characteristics. A monitoring plan for the Racoon River has yet to be completely developed.

Phased TMDLs are written when there is inadequate information available to establish final loadings. Since a phased approach has been used to develop most current TMDLs in Iowa and such an approach is expected to be used for TMDL development into the foreseeable future, monitoring commitments must be designed to accommodate this phased approach to TMDL development.

Sediment Data for Evaluating Impact of Bed and Bank Erosion

Bed and bank erosion appears to be a major contributor to several identified stream sediment and siltation impairments in Iowa but rigorous methods for evaluating these sources of impairment are currently lacking. The Agricultural Research Service and a regional work group have been working on a stream channel evolution model and other sediment evaluation procedures that may yield monitoring strategies.

Event Sampling

As indicated previously, stream flow measurements, including event sampling, are crucial for TMDL development but most smaller streams in Iowa have never been gaged and storm event data is entirely lacking. Furthermore, given current funding constraints, establishment of continuous stage monitoring appears to be beyond the current capacity of the program. To deal with this significant data deficiency, IDNR hopes to develop its own ability to gage small streams using new technologies such as Doppler Radar, which has been successfully implemented in other states (Minnesota). Other options include renting a suite of portable flow monitoring equipment which could be moved to different locations as needed.

4.9 Areas in Need of Additional Study

Prior to completion of the final report evaluating IDNR's surface water monitoring program, additional review and evaluation will be undertaken in the following areas: use of specific models in decision-making and their appropriateness, particularly with regard to TMDL development; use of specific statistical tests for verifying compliance with water quality standards; and, following completion of all sections of CALM or future EPA guidance documents, the degree of compliance of IDNR assessment process with those new guidance document (IDNR did not attempt to come into compliance with the new CALM guidance for 2002).

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ACRONYMS

CAFO	Concentrated Animal Feeding Operation
CALM	Consolidated Assessment and Listing Methodology
CPCB	Central Plains Center for BioAssessment
CWA	Clean Water Act
DO	Dissolved Oxygen
DOT	Department of Transportation
FDA	Food and Drug Administration
EDAS	Ecological Data Application System
FTE	Full-time Employee
GIS	Geographic Information System
HHC	Human Health Criteria
HUC	Hydrologic Cataloging Unit
IAC	Iowa Administrative Code
IBI	Index of Biotic Integrity
IDNR	Iowa Department of Natural Resources
IGSB	Iowa Geological Survey Bureau
IOWATER	Iowa's Volunteer Monitoring Program
ISU	Iowa State University
LTRMP	Long Term Resource Monitoring Program
MCL	Maximum Contaminant Level
NASQAN	National Stream Quality Accounting Network
NAWQA	National Water-Quality Assessment
NPDES	National Pollution Discharge Elimination System
NRCS	National Resource Conservation Service
NSIP	National Stream Information Program
PAH	Polycyclic Aromatic Hydrocarbons
PBT	Persistent Bioaccumulative Toxics
QA/QC	Quality Assurance/Quality Control
R-EMAP	Regional Environmental Monitoring and Assessment Program
RLWA	Rathbun Land and Water Alliance
RTAG	Regional Technical Advisory Group
SDWA	Safe Drinking Water Act
SSURGO	Soil Survey Geographic Database
STORET	USEPA's Storage and Retrieval Database
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
TSI	Trophic State Index
UHL	University Hygienic Laboratory
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGS	United States Geological Survey